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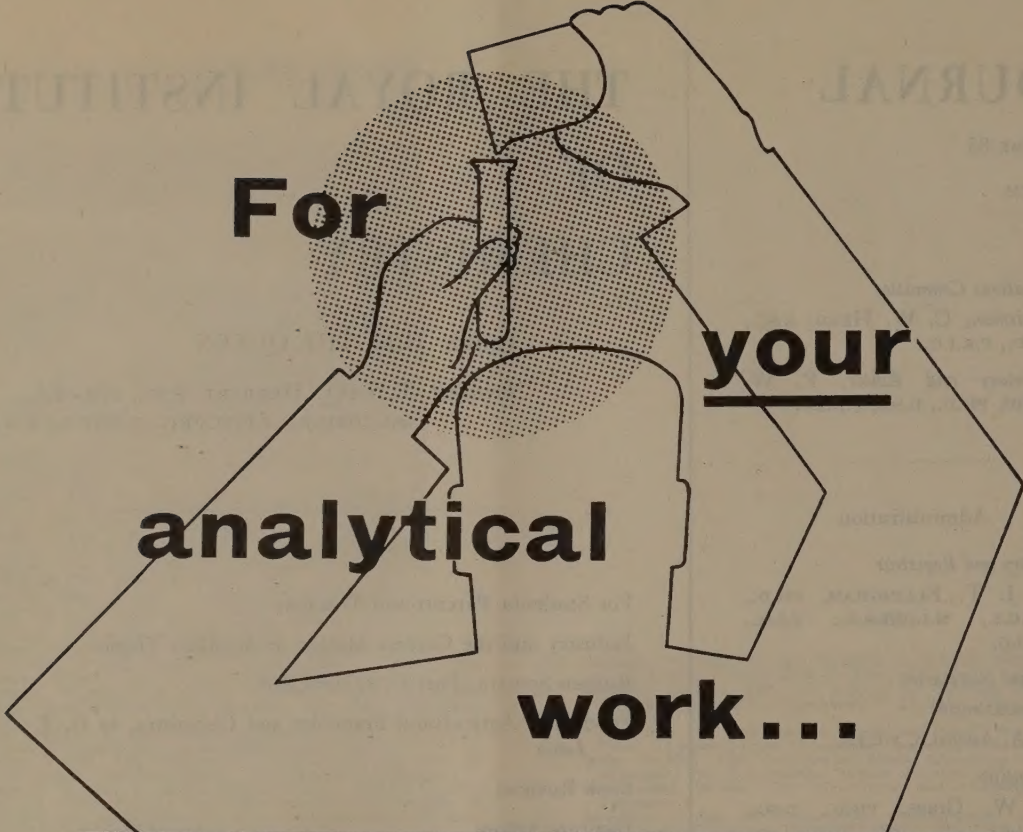
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# FOR STUDENTS, PARENTS AND TEACHERS

## REVISED SCALE OF GRANTS TO STUDENTS

The Anderson Committee on Grants to Students, in its Report published in May last, was divided as to how far, if at all, parents and award-holders should contribute towards the cost of their courses. However, with one exception the Committee were agreed that if parental contributions were, in fact, retained, they should be much smaller than at present.

The revised scale of parental contribution recently announced by the Minister of Education in the House of Commons means that 40 per cent of university students, compared with the present 25 per cent, will receive full grants. At the same time parents retain the income tax child allowance.

On the present scale parental contributions are calculated as 14 per cent of the balance of income over £450 (no contribution being required below £525). The revised scale requires a contribution at the rate of 8 per cent on the balance of income in excess of £600 up to £1,400 (no contributions being required from parents whose balance of income is less than £700). The additional contributions required from those whose balance of income exceeds £1,400 will be 10 per cent.

Any student will be eligible for an award if he obtains a place at a university or other institution for a degree course or a course leading to an equivalent qualification. This represents a fundamental change from the existing system of selection for awards by Local Education Authorities; there will, in future, be a national standard.

## ADMISSION OF STUDENTS TO UNIVERSITIES

The third report of the committee on procedure for admission of students to universities has recently been published by the Association of Universities of the British Commonwealth (36 Gordon Square, London, W.C.1; price 2s. 6d.). This *ad hoc* committee, under the chairmanship of Sir Philip Morris, was appointed by the Committee of Vice-Chancellors and Principals in January, 1958.

In the first report, issued in May 1958, a number of recommendations were made to reduce the difficulties experienced by candidates for admission to universities (*J.*, 1958, 568). These recommendations were generally adopted by the universities and a survey of what had been achieved was published in the second report, issued in June last year (*J.*, 1960, 310).

In the third report the committee has taken the opportunity to bring up to date information as to the number of applications received by the universities and the number of admissions. The main conclusion is that

the universities must consider, as a matter of urgency, the establishment of a central organization and a central office to handle applications.

The simplified admission procedure suggested in the first report has benefited mainly the students and the schools from which they come. Meanwhile difficulties within the universities have been increasing, largely because of the steep rise in the number of applications received by each. In 1955 there were about 70,000 applications from some 31,000 candidates for 18,000 university places. The number of applications for the current session reached about 151,000 for some 22,650 admissions. (These figures are exclusive of applications to Oxford and Cambridge.) The number may well reach, or exceed, 200,000 by 1964, even disregarding the peak of the population 'bulge' which will reach universities at about that time. Though the number of candidates since 1955 has increased, so also has the average number of applications submitted by each candidate—three to four applications against about two for 1955.

This appears true for all vacancies except for courses in technology. The number admitted to such courses in 1960 was 12 per cent greater than in 1959, but the number of applications remained almost unchanged. The number of 'vacant places' in technological courses on 15 October, 1960, was 374, most of which were in the classical engineering subjects. In other faculties the number of 'vacant places' was relatively low compared with the previous year; for instance a total of 89 in pure science compared with 185 in 1959. The committee attributes this, in part, to the contribution made by 'clearing-up houses,' which were established on an experimental basis for certain subjects last year.

It is obvious from the above figures that heavy burdens are already falling on the university selection staffs. The committee has concluded that without effective co-ordinated and pre-arranged action the universities will be driven by 1964, or earlier, to take individual unconcerted measures, which would cause great difficulties for candidates and schools. Each university, in seeking its own remedy, could hardly fail to create difficulties for the others.

## THE PROPOSALS

A working party set up in June 1960, under the chairmanship of Dr A. W. Chapman, Registrar of the University of Sheffield, has recommended two schemes to the *ad hoc* committee (referred to as X and Y).

These provide for a central office, suitably equipped with data-processing machines, to which each candidate would make his application, naming a number of institutions to which he wishes to apply. The central office would distribute his applications to the institutions

concerned, act as a channel through which all offers or rejections are conveyed to the candidate, ensure that no other application remains in force once a candidate has firmly accepted an offer, provide a general clearing-up service and make full information available to those who need it. Both schemes provide that though any candidate can conduct whatever inquiries or negotiations he likes with any university, the actual application must be made through the central office and every formal offer, firm or provisional, and every rejection must be made and accepted or declined through the central office. The two schemes differ in that under scheme X a candidate's applications would be released two at a time, in a specified order chosen by the candidate. A second pair of applications would be issued only after the results of the first pair had proved unacceptable. This scheme offers the most effective way of reducing the work of selectors. Under scheme Y all applications would be issued simultaneously though they would be clearly distinguished as first choice, second choice, 'other choices', or 'no preference'.

The *ad hoc* Committee suggests that a conference of representatives of the universities should be convened to consider the two commended schemes and, if favourably received, to authorize the establishment of a central office to be equipped and staffed by early 1962 so that it would be in full working order for the session 1963-64.

#### WEAKNESSES IN THE SCHEMES

These recommendations would undoubtedly reduce the difficulties of universities, schools and individual candidates at a time when the present system is getting almost out of hand.

There are, however, two major weaknesses. First, the report does not cover the universities of Oxford and Cambridge because of their different methods and different timetables of selection. So long as these two universities remain outside the proposed scheme, difficulties for schools and students will exist and the pressure on candidates will continue. The report expresses the hope that Oxford and Cambridge will give sympathetic consideration to the possibility of joining the scheme. Their participation would certainly be welcome and they could make an important contribution to its success.

Secondly, the terms of reference of the committee necessarily restricted its deliberations to the problems of university institutions. But the difficulties of the candidates and the schools extend to admission into any type of full-time, or sandwich, course leading to a degree or equivalent qualification, whether it be at a university or technical college. In chemistry alone there are many full-time or sandwich courses leading to an internal or external degree of the University of London, to the Grad. R.I.C. or to the Dip. Tech. in operation at institutions outside the sphere of the University Grants Committee. Their difficulties are similar to those that face universities but unfortunately their task of selection is often frustrated to a far greater extent by last-minute

withdrawals. This can only lead to courses beginning with vacant places or with students of inferior calibre. Technical colleges that offer full-time courses at degree level have a greater need of a 'clearing-up house' system than many of the established universities. The standard of entry to, say, a Dip. Tech. course is, or should be, just as high as for a course leading to a university degree. It would be a great advantage, therefore, if the proposed central organization could be empowered to deal with admissions to all institutions, or at least to assist with the filling of late vacancies in all types of courses leading to a degree or equivalent qualification. The transition from school to university or technical college should be as smooth as possible, and a significant contribution to this end will be achieved if admission procedure and selection in all institutions can be integrated. No doubt this will be considered by the Robbins Committee on higher education, but will these recommendations be available before drastic action has to be taken?

#### STATE SCHOLARSHIPS

One of the main recommendations of the Anderson Committee Report, *Grants to Students* (J., 1960, 309), was that state scholarships should be discontinued. After consultation with local education authorities, universities, schools and other interested bodies, the Minister of Education has accepted the Committee's recommendation, except in so far as it relates to Mature State Scholarships, to take effect after the 1962 competitions. Thus in 1961 and 1962 it is proposed to award 1850 State Scholarships and up to 255 Technical State Scholarships, but not thereafter. Similarly, any student who wins a university or college award which is on the Ministry's lists for supplementation and is recommended to the Ministry by the university or college authorities by 30 September, 1961, will be considered for the offer of a Supplemental State Scholarship.

Hitherto certain winners of State Scholarships have been allowed to postpone taking up their awards for one or two years, but this will cease in 1964.

The Minister has also accepted, with effect from the academic year 1961-62, the Committee's recommendation that award-holders should be allowed to retain each year, without reduction of their grant from public funds, up to £100 of personal income including income from scholarships; more detailed information about this will be given later.

It is the intention to continue to award up to 30 State Scholarships for Mature Students annually on the same conditions as hitherto so long as suitable candidates present themselves.

The Minister is considering separately what changes, if any, will be desirable in the structure of the G.C.E. examination at Advanced level after the cessation of State Scholarship competitions.

D. G. C.

# INDUSTRY AND THE CAREERS MASTER

By SIR MILES THOMAS, D.F.C., M.I.MECH.E., M.S.A.E.

*Chairman, Monsanto Chemicals, Ltd\**

I consider this question of careers very important business. We are apt to think it really matters only to the individual who, at a tender age, has to make a choice as to how he is going to earn his living. But it is much more important than that. It is important to the company or organization that is going to employ him, and it is very important indeed to the country as a whole.

The entire future, not merely economically but in every sphere of human activity, belongs to these young people who every year are called upon to make a decision as to the kind of career they will follow. If they choose wisely the country benefits. If they choose badly the country suffers, and the future of our people is imperilled. You may think I dramatize the situation, but not a bit of it. The race, in this complex modern world, is no longer to the swift but to the best qualified. Square pegs in round holes are a luxury we can no longer afford.

So without too much oversimplification I believe that not merely our national livelihood but our very existence depends upon the wisdom of the choice these not very experienced young people may make in the question of a career. That means that they can't—they *mustn't*—be left to make that choice unaided. They must have advice, the best advice that can be made available to them. And this is where you come in, for it is to you that some of the best of them turn for assistance.

I hope I have established the importance with which I view the problem of careers advice. A country may have—and I believe we have—the richest source of intellectual and practical talent in the world, but if it is misdirected it is all wasted. In the past our economic strength made such waste regrettable but not disastrous. Today our skilled brainpower is our *only* real wealth and to waste it is to opt for national suicide.

There is another important factor to be borne in mind. National service is coming to an end. Sighs of relief in their thousands are doubtless being heaved at this prospect, but national service had one great advantage which may not have been generally appreciated. It gave the school-leaver, however uncongenial his pursuits in the meantime, an opportunity to look about him, to mature a little, to see life from a different angle before plunging in head first. For many it served simply to confirm the choice of career already made. For others it brought about a complete upheaval, intellectually as well as physically, resulting in a career undreamed of two years earlier.

All this is gone now. There will be no enforced pause, even after a period of further education at a

university or elsewhere. The decision must be taken at an age when one's knowledge of the world is limited and distorted. Today even the schoolboy with a prospect of some further years of undergraduate and postgraduate study is well advised to have a fairly firm idea of what he expects to do when he leaves school.

And this is where all of you come so importantly into the picture, because these young men, most of whom will have to make up their minds about a job at the age of 18 instead of 20, will, if they have any sense, come knocking at your door for guidance.

One thing they are going to find is that they will have to specialize more than was expected of boys in their position not so many years ago. Indeed, it is common experience in industry to find young men applying for jobs which they understand only vaguely and which they are ill-equipped to fill. This is not infrequently because they were not properly advised at the age of 16 as to subjects and prospects. So specialize they must and almost certainly will.

Now, the great question is this—have *you* specialized? I must be blunt and say that in my opinion career advice as asked for and given—or perhaps as not asked for and not given—has a long way to go.

Considerable progress has been made in recent years, but one still hears occasionally of the careers master who is appointed because he is the one in the staff room with the least work to do. This fills me with dismay. Careers advice is too important to be so treated, putting it in the same category as supervising school meals or collecting 'milk money.'

Little imagination is needed to see what happens in such cases. The tenuous but all-important thread between the boy and his future is broken. No one notices at the time, but the eventual consequences may be far-reaching. How many boys, I wonder, have all unwittingly suffered in this way? How many thousands, hundreds of thousands, are today living what Thoreau called 'lives of quiet desperation' because they lacked a little expert guidance that might have turned them aside from a soul-destroying 'job' and directed them into something more spiritually as well as economically rewarding?

Career selection is—or should be—one of the most delicate and important skills in human experience. You can force a peg into a hole of the wrong shape and size, but if you try to do the same thing with a human being, particularly a young one, you may damage him irreparably. And neither he nor you may ever know that the

\* An address given on 3 January at the 34th Careers Masters' Convention (see *J.*, 74).

damage has been done, or how tragic are its consequences. This is a measure of the challenge.

To have a door with 'Careers Master' written over it is not enough. The careers master is the most important peg of all. If *he* does not fit into his hole then woe betide all the pegs he in his turn will be called upon to handle.

Some of the strongest critics of careers masters have been schoolboys themselves. Common complaints are that careers masters paint industry too black, or stigmatize it as the haven of those with second-class minds—those who do not possess the ability for an academic or professional career. It would be interesting to discover whether any of you who may privately entertain such views will find them reinforced or weakened during the next few days.

However, I believe it is becoming more and more essential for careers masters to maintain close contact with industry and the various opportunities it has to offer. Do not rely on your own personal theories about industrial careers. Unless you have worked in industry yourselves, and for a considerable period, they are almost certain to be wrong. And even if you have they will be out of date, for industry changes from year to year, almost from day to day, in the prospects it offers to the potential recruit.

I want to emphasize one point, though. The contact should be between industry and the careers master, *not* between industry and boys. I believe that it is a great mistake to allow individual companies to visit schools and to talk to sixth formers with a view to recruitment.

The present university drag-net is bad enough, but after a year or two at university a boy has acquired a little self-protective cynicism. He is also able to compare notes with others, frequently older and more experienced, who can lend him dark glasses with which to face the hypnotic dazzle of the recruiters.

The schoolboy is much more vulnerable, and can easily get a distorted picture of what a post in industry is like. The contact here should be maintained by the careers master, who should find the time to visit different industries. You cannot carry out your job of careers master as a sideline to teaching; it has got to be part of the main-stream of your job. The chemical industry—and I know I speak for all other industries too—would welcome and do much to encourage greater contacts with schools careers masters. We are only too anxious to tell you what kind of boys we want and what kind of background they must have.

We would also be very happy to supplement your own direct contact by arranging factory visits by your boys on an informational rather than a recruitment basis. These visits can do much to help a boy decide whether it is in such surroundings that he could find a happy and worthwhile home.

What sort of people do we want in the chemical industry? Obviously the main need is for scientists of many kinds: chemists, physicists, chemical and mechanical engineers—even pure mathematicians; and many others in lesser numbers. All of them, needless to say, must have reached graduate level or the equivalent.

I must make a second point here. It is essential that boys who intend to follow this kind of career reach their 'A' level at school. They must not be allowed to substitute a non-essential subject simply because they happen to be better at it than, say, mathematics, which is the basis of most scientific training. Mathematics has been called the handmaiden of science. We must exhort budding scientists to get to know the lady intimately whether or no they like the look of her face.

The commercial side of the industry too has a great need for scientists but also scope for arts graduates and for boys who come straight from school at the age of 18 or 19. The man with a specialized scientific training does not always have the qualifications needed for management and administration, and a more general education can frequently fill the bill here.

On the other hand, the non-scientist does not have to file a 'flight plan' of his academic years in advance, though this is becoming increasingly necessary for the scientist. The non-scientist has more freedom to make up his mind about a career at a later stage. This is a mixed blessing if one is not quite sure which way to jump, but fortunately there are openings in the chemical industry for such people, even though comparatively limited. Perhaps I can sum it up by saying that for those who can offer the right combination of intelligence and adaptability the jobs are there.

But what does the peg think of the hole? What do the young men of this country think of the chemical industry? During the 1950s, when employment rose by some 775,000 between 1949 and 1957, the numbers working in the chemical and allied industries went up by more than one tenth of that total. Certainly the industry is one of the great loadstones for the youth of today. 'Chemicals' and 'plastics' seem synonymous with expansion, and expansion means opportunity.

We hope that you will encourage them in this attitude as a result of what you learn from us in the next few days, because we believe they are right. We need them, and shall continue to need them in ever-growing numbers. But we need you, the careers masters, more, for we are sure that it is only with your help that we shall get the right men into the industry. You are our key men in the outside world. If we want to convince you of anything it is that we regard you and your work as vital to the future of our industry and of this country. The extra and heavy responsibilities which the job of a careers master should carry deserve better recognition—and I do not mean simply in status!

# RAMAN SPECTRA

By JOHN ROSE, M.Sc., Ph.D., F.R.I.C.

Senior Lecturer in Physical Chemistry, Birkenhead Technical College

## PART I

The Raman shift was predicted by Smekal<sup>1</sup> in 1923 but first observed by Raman<sup>2</sup> in 1928. This effect is concerned with a particular aspect of light-scattering by a transparent medium. Three light-scattering processes exist: (i) the Tyndall type arising from randomly distributed colloidal particles, the dimensions of which approximate to the wavelength of visible light; (ii) the Rayleigh type, due to transitory changes in the index of refraction caused by local variations of density in the medium; (iii) Raman scattering, which is related to molecular polarizability and arises from fluctuations in the 'refractive index' of single molecules. Since these changes, which are produced by molecular rotations and vibrations, are relatively small, the intensities of Raman spectra will also be low. A special optical technique is thus required to study the Raman-Smekal effect.<sup>3</sup> Briefly, monochromatic radiation R (visible or ultraviolet) from an intense source S (Fig. 1), placed

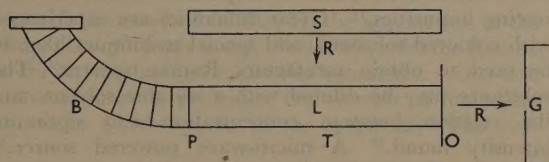


FIG. 1.

concentrically round a transparent tube T, is scattered by the sample in T, and the portion of the light scattered at right angles to the incident radiation (Rayleigh and Raman scattering) is allowed to enter the spectrograph G. Direct and reflected radiation is eliminated by studying the radiation scattered at right angles to R and by using a Wood's tube. One end of this tube is horn-shaped and blackened (B) to trap stray reflected light, while the other end has an optically flat window (O) facing the spectrographic slit. The total intensity of the scattered light is increased by having a long (L) portion of the tube T. Modern instruments have a simplified version of this tube, the horn-shaped part being replaced by a rubber jacket surrounding the end P. The tube is then mounted vertically, and the scattered light directed from O to G by means of a reflecting prism.

The Raman effect differs from the other types of scattering in a fundamental manner and presents the following characteristic features:

(a) The Raman effect is due to 'molecular' events;

- (b) Monochromatic exciting radiation gives rise to several new frequencies which constitute the Raman spectrum (the Tyndall and Rayleigh scattering involve the exciting frequency only);
- (c) The Raman lines are sharp and discrete. For a given substance the differences between the exciting and Raman frequencies, *i.e.* Raman shifts, are the same irrespective of the exciting frequency;
- (d) The Raman frequencies are symmetrical about that of the incident radiation. The lines on the low-frequency side, known as Stokes lines, are much stronger and more useful than those on the high-frequency side, known as 'anti-Stokes' lines. The former arise when the final state of an excited molecule after emission of light has more energy than the initial state. The 'anti-Stokes' lines appear when the final state has less energy than the initial state;
- (e) The Raman shifts are of the order 1 to 20  $\mu$  (100 to 10,000  $\text{cm}^{-1}$ ). For instance, for carbon disulphide the difference is  $\pm 656 \text{ cm}^{-1}$  for the exciting frequencies 22,938  $\text{cm}^{-1}$  (4,358 Å) or 18,308  $\text{cm}^{-1}$  (5,461 Å). Fig. 2 shows this for carbon tetrachloride. It is important to note

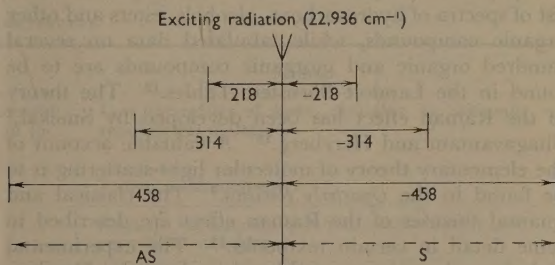


FIG. 2.

that the Raman shift is independent of the exciting frequency provided that the latter is not too close to an electronic absorption band;

- (f) Raman lines show, in general, a marked depolarization; the Rayleigh line is highly polarized;
- (g) The intensity of a Raman line is about  $10^{-1}$  to  $10^{-3}$  that of a corresponding Rayleigh line for a liquid medium; it is a hundred times weaker for gases

than liquids. In solids, however, the Raman intensity is equal to that of the Rayleigh scattering, since the latter is relatively weak;

- (h) Raman scattering is incoherent, *i.e.* there is a random phase relationship between the incident and scattered radiation;
- (i) The Raman spectrum, *i.e.* frequencies, intensities and states of polarization, are characteristic of the transparent medium used.

#### APPLICATIONS OF THE RAMAN EFFECT

The scope and importance of the discovery of the Raman effect are shown by the enormous volume of publications devoted to this subject. Up to 1936 about 1,400 published papers dealt with the application of this effect to organic and inorganic molecules. About 1,200 papers appeared in 1936–39; Hibben<sup>4</sup> mentions over 1,700 papers up to 1939. This enormous flow dwindled during the war (700 papers). The revival of interest in Raman spectra in the post-war period is shown by the vastly increased volume of work (nearly 2,400 papers in the decade beginning in 1945). The spate of papers is increasing continuously, and rivals those devoted to infra-red spectra. Most of the pre-war data were summarized by Hibben<sup>4</sup>; Kohlrusch<sup>5</sup> and Glockler<sup>6</sup> dealt with the literature up to 1943, while Pajenkamp<sup>7</sup> and Andermann<sup>8</sup> surveyed the work done in the post-war period. Valuable information is contained in the annual reviews of Raman spectra in *Analytical Chemistry*, in the *Annual Reports on the Progress of Chemistry* and in the *Quarterly Reviews of the Chemical Society*.<sup>9</sup> In addition, the American Petroleum Institute *Project 44 Collection*<sup>10</sup> and papers in *Analytical Chemistry*<sup>11</sup> contain an extensive list of spectra of hydrocarbons, alcohols, esters and other organic compounds, while tabulated data on several hundred organic and inorganic compounds are to be found in the Landolt-Börnstein Tables.<sup>12</sup> The theory of the Raman effect has been developed by Smekal,<sup>1</sup> Bhagavantam and Herzberg.<sup>13</sup> A valuable account of the elementary theory of molecular light-scattering is to be found in the *Quarterly Reviews*.<sup>9</sup> The classical and quantal theories of the Raman effect are described in some detail in certain textbooks.<sup>14</sup> The experimental techniques have been considered in detail by Harrison *et al.* and by Jones and Sandorfy,<sup>15</sup> as well as in the various annual reviews in *Analytical Chemistry*.

#### GENERAL CONSIDERATIONS

Infra-red and Raman spectra arise from rotational and vibrational energy levels of a molecule. For simple molecules endowed with a relatively high degree of symmetry it is possible by means of both spectra to determine molecular structure. Unfortunately, most of the complex organic molecules do not possess sufficient symmetry, so that a mathematical treatment of the

problem is beyond the limits of modern theory. Infra-red and Raman spectra do, however, yield useful information about the molecular structure of even complex molecules, especially if mass-spectrometric and radiochemical data are available as well.

In general, infra-red and Raman spectra give the same type of molecular information, since they are both associated with molecular vibrations, though they depend on different electrical characteristics of the molecule. There is, however, a sharp difference between the intensities of corresponding bands in the two types of spectra, especially for molecules endowed with a high degree of symmetry. Indeed, some infra-red bands may be totally absent, while the corresponding Raman spectra may be very intense, and vice versa. This differentiation is greater the higher the symmetry of the molecule, and the choice between the two techniques is based on convenience and availability of suitable instruments. Table I shows the advantages and limitations of both procedures. The dominant position held at present by the infra-red technique is essentially due to the availability of infra-red spectrometers of great speed and accuracy, though the gap between the two techniques is being steadily narrowed, and Raman spectrometers of high speed and resolution are becoming available. Most of the work on Raman spectra has been carried out with pure liquids which do not contain even traces of suspended matter or fluorescing impurities.<sup>16</sup> Great difficulties are experienced with coloured solutions, and special techniques have to be used to obtain satisfactory Raman spectra. The substance may be diluted with a suitable solvent, and the relation between concentration and optimum intensity found.<sup>17</sup> A micro-wave powered source,<sup>18</sup> consisting of a number of electrodeless lamps containing mercury, helium or sodium, has been used with success for coloured samples.

Raman spectra of solutions are weak, the intensity decreasing with increasing dilution. These intensities depend in a complex manner on the polarizability of the molecules and various experimental factors,<sup>19</sup> and there is no general relation similar to Beer's law for absorption spectra.<sup>20</sup> The scattering intensity of a Raman band varies as the fourth power of the exciting frequency, except in the absorption region. With hydrocarbons,<sup>21</sup> the intensity of the maximum of the band varies directly, and not logarithmically, as the concentration (expressed as the volume fraction). This is of importance in analysis. Complex formulae have been derived to express intensities of Raman bands in terms of theoretical and experimental factors.<sup>22</sup> Despite these drawbacks, extensive use has been made of Raman spectra in chemical analysis and in the study of acid equilibria in aqueous solutions, including zwitterions.<sup>23</sup> Indeed, in some cases excellent agreement was found between experimental values and those calculated by means of quantum mechanics and perturbation theory.<sup>24</sup>

Studies on gases are complicated by experimental difficulties because of the low intensity of the Raman effect. More intense sources, multiple reflection tubes and other refinements have been found satisfactory for the measurement of the rotational fine spectrum of benzene in the gaseous phase.<sup>25</sup> The spectra of gaseous hydrogen peroxide,<sup>26</sup> organic peroxides<sup>27</sup> and alcohols<sup>28</sup> have been studied in detail. It has been possible to reduce exposure times from 40 hours to one or less by the use of photo-multiplying devices. A marked advance has been the introduction of a double-grating monochromator to reduce stray radiation and Tyndall scatter from the sample.<sup>29</sup> Strong bands are thus obtained, especially with liquids. In fact, a micro-technique was found to be satisfactory with liquids (0.1 ml) at a scanning speed of  $10 \text{ cm}^{-1} \text{ sec}^{-1}$ . The use of high-current water-cooled mercury arcs,<sup>30</sup> of high-current low-pressure mercury lamps<sup>31</sup> and elliptical mirrors, to obtain maximum efficiency,<sup>32</sup> improve the appearance of spectra. Turbid solutions can also be studied by means of suitable apparatus.<sup>33</sup> Cooling of the samples to low temperatures gives, except with carbon disulphide, sharper and more intense spectra,<sup>34</sup> probably due to the suppression of rotational isomerism at low temperatures.

#### MOLECULAR STRUCTURE AND THE RAMAN EFFECT

As will be described in Part II, the application of the Group Theory<sup>35</sup> leads to sets of selection rules for Raman spectra on the basis of molecular symmetry. One can thus determine, in principle, the number of molecular frequencies which appear in the spectrum. The pro-

cedure consists of comparing the observed spectra with those predicted by the selection rules for an assumed structure. This process can be repeated for every possible molecular symmetry compatible with the number and nature of the atoms and bonds. Unfortunately, two or more of the assumed models frequently explain the spectrum equally well. The use of mass spectra and isotopic techniques is, therefore, of primary importance for deciding the true structure of the compound.<sup>23,36</sup> It is also to be noted that bond angles cannot be evaluated by means of Raman spectra alone, though bond distances can be calculated from spectral data of the Raman effect.

In general, the procedure of fitting experimental data to a given model is not followed in Raman spectroscopy, contrary to the method adopted in the infra-red technique, for the symmetry of most molecules is too low and the number of vibrational modes too large to yield strict selection rules and exact equations. The vibrational spectra of the Raman type of even simple organic molecules are complex. For instance, a molecule containing 20 atoms will have 54 fundamental vibrations, and with the additional overtones and combinations will yield a highly complex spectrum. There are, of course, certain simplifications. Thus certain groups of atoms and types of linkages give rise to characteristic vibration bands, irrespective of the rest of the molecule, though slight displacements occur. For example, the average Raman shift for a C-H frequency is  $2,918 \text{ cm}^{-1}$  in aliphatic compounds, and  $3,054 \text{ cm}^{-1}$  in aromatic compounds; with the latter, the aliphatic shift appears as well. The main shift in methane is  $2,918 \text{ cm}^{-1}$ , but other minor shifts occur as well. There are two shifts

TABLE I  
INFRA-RED AND RAMAN SPECTRA

Aspect	Infra-red	Raman
Spectra of gases	Excellent, except for diatomic symmetrical molecules (owing to their not absorbing in the infra-red region)	Low intensities of lines. Suitable for diatomic symmetrical molecules
Spectra of liquids	More suitable than Raman	Rather weak intensity
Spectra of solutions	Unsuitable for aqueous solutions	Suitable for aqueous solutions; unsatisfactory for very dilute solutions
Spectra of solids	Suitable	Suitable
Coloured media	Satisfactory	Unsuitable
Fluorescent media	Satisfactory	Not suitable unless quenched
Photosensitive media	Rare occurrence	Unsuitable
Wave-length range	2-20 $\mu$	No limit; can be observed down to $100 \text{ cm}^{-1}$ ; shifts observed in suitable regions by a proper choice of exciting radiation
Overtone	Intense overtones detrimental to analysis	Very weak overtones
Apparatus	Photoelectric instruments of high speed and resolution	Quality of modern instruments approaching that of infra-red spectrometers

in ethane ( $\text{C-H}$ , 2,900 and 2,955  $\text{cm}^{-1}$ ) and a  $\text{C-C}$  shift of 993  $\text{cm}^{-1}$ . These main shifts persist in aliphatic compounds with only slight alterations (in butane the  $\text{C-C}$  shift is 834  $\text{cm}^{-1}$ ), but additional Raman displacements occur as well at 800–1,100  $\text{cm}^{-1}$ . The characteristic Raman shifts for unsaturated linkages, carbonyl groups, isomers of various types and all kinds

of groups and links, as shown in Table II, have proved of immense importance in the field of structure determination. Other factors, which restrict the complexity of spectra, are limitations to coupling between vibrations of like groups in large molecules, and the occurrence of high-intensity spectra owing to the presence of certain atomic groups or linkages.

TABLE II  
SOME RAMAN GROUP FREQUENCY SHIFTS (VIBRATION)

Group frequency shift ( $\text{cm}^{-1}$ )	Types of vibration	Example	Remarks
332	Out-of-plane bend $-\text{S}-\text{H}$	Mercaptans	
234–334	$\text{C}-\text{C}$ bend	n-Paraffin hydrocarbon chain	Weak if long chain
560–610	$-\text{O}-\text{NO}_2$ bend	Nitrate esters	Strong
600–700	$\text{C}-\text{SH}$ stretching	Mercaptans	Strong (weak infra-red)
700–1,200	Ring vibrations	Cycloparaffins	The greater the number of atoms the lower the frequency
1,268	Symmetrical ring vibrations	Ethylene oxide	Strong (weak infra-red)
1,303–1,306	$>\text{CH}_2$ wag	Linear hydrocarbon chains	As above
1,200–1,450	$-\text{C}=\text{C}-\text{H}$ in-plane $\text{C}-\text{H}$ bend	Substituted ethylenes	As above
1,130–1,350	$>\text{CH}_2$ wag and twist	Polymethylene chain	Raman and infra-red equally strong
1,390	$\text{NO}_3^-$ vibration	Nitrate ion	
1,409–1,434	$-\text{N}=\text{C}=\text{O}$ symmetrical stretch	Alkyl isocyanates	Strong Raman
1,571	$-\text{C}=\text{C}-$ stretch	$\text{Cl}_2\text{C}=\text{CCl}_2$	Weak Raman
1,576	$-\text{N}=\text{N}-$ stretch	Azomethane	Weak infra-red
1,590–1,610	Ring vibrations	Aromatic hydrocarbons	Intense Raman, weak infra-red
1,650–1,820	$>\text{C}=\text{O}$	Carbonyl group	As above
1,974	$-\text{C}\equiv\text{C}-$ stretch	Acetylene gas	Intense Raman
2,049	$>\text{C}=\text{C}=\text{O}$ stretch	Ketene	As above
2,118–2,125	$-\text{C}\equiv\text{C}-$ stretch	Mono-alkyl acetylenes	Very strong Raman
2,080–2,169	$-\text{N}=\text{N}^+=\text{N}^-$ asymmetric stretch	Alkyl azides	
2,304	$-\text{C}\equiv\text{C}-$ stretch	Dialkyl acetylenes	
2,329	$-\text{C}\equiv\text{N}$ stretch	Cyanogen	No infra-red
3,019	$=\text{C}-\text{H}$ stretch	Ethylene gas	As above
3,047–3,062	$=\text{C}-\text{H}$ stretch	Benzene	Intense Raman
3,045–3,070	$=\text{C}-\text{H}$ stretch	Mono-, di- and tri-substituted benzenes	As above
3,374	$\equiv\text{C}-\text{H}$ symmetrical stretch	Gaseous acetylene	No infra-red
3,150–3,636	$-\text{O}-\text{H}$ stretch	Hydrated salts	Broad lines
4,400	$\text{H}-\text{H}$ stretch	Hydrogen gas	No infra-red

Raman frequencies fall, in general, into four classes—

- (1) Frequencies between 4,400 and 2,800  $\text{cm}^{-1}$ , characteristic of groups containing the hydrogen atom;
- (2) Those between 2,400 and 1,900  $\text{cm}^{-1}$ , indicating a triple bond;
- (3) Those between 1,800 and 1,300  $\text{cm}^{-1}$ , generally resulting from compounds containing double bonds;
- (4) Frequencies between 1,000 and 300  $\text{cm}^{-1}$ , characteristic of compounds with single bonds with the exception of those containing the hydrogen-halogen link.

For compounds containing several link types all corresponding Raman shifts will be represented, since one type has only a slight effect on the others. For instance, the carbonyl shift is slightly raised in various compounds by introducing halogen atoms. On the other hand, this shift varies with the nature of the compound containing the carbonyl group. For example, in alkyl esters the value is about 1,730  $\text{cm}^{-1}$ , in ketones 1,705  $\text{cm}^{-1}$ , and in aldehydes 1,718  $\text{cm}^{-1}$ .

Despite the great advances made in the field of Raman spectroscopy, the fitting of experimental data to an assumed model—a standard infra-red technique—has not been attempted to a marked extent for reasons given on page 85. Some successful attempts have, however, been made in this connection. Thus, satisfactory agreement has been found between theoretical predictions and experimental results in the case of long-chain polyenes,<sup>37</sup> cyclo-octane,<sup>38</sup> and liquid osmium hexafluoride,<sup>39</sup> to cite a few examples. In this connection, Raman techniques have been combined with infra-red, proton magnetic resonance, dipole moment, ultra-violet absorption and other data,<sup>40</sup> the compounds studied ranging from aromatic hydrocarbons and substituted silanes to iodic acid.

#### ISOMERISM AND RAMAN SPECTRA

In unsaturated carbonyl compounds the conjugation of the C=C link with the C=O link leads to a decrease of the carbonyl shift by about 40 units, while in  $\alpha\beta$ -unsaturated acids this shift is almost eliminated. It follows that this effect can be used for detecting the presence of enols in keto-enol mixtures. For instance, a characteristic shift is observed with acetoacetic esters and their monoalkyl derivatives; dialkyl derivatives do not, of course, produce such shifts, since enolization is not possible. Similarly, it is possible to follow substitution reactions and to state the resulting structures. For example, the attachment of the alkyl group to one of the two carbon atoms linked by a double bond yields spectra which depend on the position substituted;  $\beta$ -substitution has a smaller effect than  $\alpha$ -substitution. The same applies to substitution in the naphthalene

ring. Furthermore, it is possible to differentiate between *o*-, *m*- and *p*-isomers, *e.g.* thiocresols.<sup>5</sup>

*Cis*- and *trans*-isomers can be differentiated by this method. The *cis*-compound usually has the lower value by some 20 units, the actual shift being 1,100  $\text{cm}^{-1}$  for allenes and 1,644  $\text{cm}^{-1}$  for conjugated ethylene bonds. A large number of compounds have been investigated, *e.g.* dichloroethylenes,<sup>41</sup> secondary monocyclic terpene alcohols,<sup>42</sup> 2-butene<sup>43</sup> and many others. In general, there are fewer strong lines in the Raman spectra of *trans*-isomers, since the latter have a more or less genuine centre of symmetry so that all vibrations antisymmetric to the centre are excluded from the Raman effect. Corroboration can be obtained by means of infra-red spectra, for the infra-red absorption bands of *trans*-isomers are weak or missing when the Raman lines are strong, and vice versa for the *cis*-isomers. This procedure is of no value when the *trans*-isomer deviates very much from the centro-symmetric structure. For many unsaturated hydrocarbons the double-bond frequency at about 1,660  $\text{cm}^{-1}$  is, however, a reliable guide, since it is higher for *trans*-forms. Indeed, it is possible to use this property for analytical estimations of isomers in mixtures.<sup>11</sup>

Other types of isomerism have also been investigated. For instance, axial and equatorial inversion isomerism of 4-bromo-1-cyclohexene in the liquid and gaseous states,<sup>44</sup> rotational isomerism<sup>40,45</sup> and the conformational type<sup>46</sup> have been studied in great detail, and theoretical predictions verified by experiment. For instance, the comparison of observed frequencies in the Raman spectrum of 2,3-dimethylbutane with the results of calculations for different models gives evidence for two rotational isomers in the liquid. The temperature dependence of Raman intensities for ethylene dichloride has been used as an indication of the amounts of *trans* (staggered) and *gauche* (skew) forms present in the pure liquid and alcoholic solution.

#### HYDROGEN BONDS

The application of infra-red and Raman techniques is of great importance in the field of structural chemistry and hydrogen bonding. An extensive review of this subject<sup>47</sup> deals with the various aspects in detail. In general, hydrogen bonding lowers the frequency of stretching and first harmonic modes and broadens the spectral lines. On the other hand, bending frequencies may be increased, though without broadening. It is to be noted, however, that infra-red techniques are preferable for solids, since crystalline compounds, unless carefully grown, give random scattering. Raman spectra, on the other hand, are superior in the regions of very low frequencies, *ca* 250  $\text{cm}^{-1}$ . Despite these drawbacks, inter- and intra-molecular association in benzene,<sup>48</sup> bonding in benzoyl chloride in benzene,<sup>49</sup> in liquid alkylamines,<sup>50</sup> and pyridine-*N*-oxide and quinoline in

various solvents<sup>51</sup> have been investigated. It is interesting to note that for pyridine-*N*-oxide the frequency is raised (1,254 to 1,266 cm<sup>-1</sup>) in methanolic solution but not in dioxan.

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**Labelling of Medicinal Preparations.**—A memorandum giving guidance on the procedure to be followed in devising labels and titles for compound medicinal preparations was published in December by the Association of British Pharmaceutical Industry, the Proprietary Association of Great Britain and the Association of Public Analysts. Representatives of these Associations have met from time to time to discuss the labelling of medicinal preparations with particular reference to Section 6 of the Food and Drugs Act 1955. The title of the document is *Labelling Procedure for Compounded Medicinal Preparations*.

**Tablet Identification Guide.**—*The Chemist and Druggist* (28 Essex Street, Strand, London, W.C.2) have recently published a new edition of their *Tablet and Capsule Identification Guide*. The Guide contains details of more than 900 tablets and capsules, including about 150 new products, contained in eight charts, five in colour. It may be obtained on washable, laminated cards, eyeleted and corded for hanging, price 17s. 6d., or in brochure form on white art paper, price 8s. 6d.

**Approved Names.**—The General Medical Council has published a supplementary list of Approved Names, February, 1961, available from the Secretary, British Pharmacopoeia Commission, 44 Hallam Street, W.1.

# FOODSTUFFS, AGRICULTURAL PESTICIDES AND CHEMISTRY

By D. T. LEWIS, PH.D., D.S.C., M.R.S.H., F.R.I.C.

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The year 1960 witnessed celebrations and exhibitions sponsored by H.M. Government to mark the centenary of the passing of the celebrated 1860 Act of Parliament<sup>1</sup> designed to prevent the 'Adulteration of Articles of Food or Drink.' All food suppliers are conversant with the first dominant clause of that Act which states that 'Every Person who shall sell any Article of Food or Drink in which to the knowledge of such Person, any Ingredient or Material injurious to the Health of Persons eating such an Article has been mixed, and every Person who shall sell as pure or unadulterated any Article of Food or Drink which is adulterated or not pure, shall for every such offence, on a Summary Conviction, etc., etc.' Many variants of this act have received Parliamentary approval during the last century, one of the most recent being the Food and Drugs Act, 1955.

One obvious consequence of such legislation relates to those questions raised in Parliament<sup>2</sup> on the effects, to both men and animals, of spraying crops with various toxic chemicals, and of the action being taken by the Ministry of Agriculture, Fisheries and Food to advise users of such pesticides on methods of application which would ensure that the hazards both to users and the general public were negligible. The term 'pesticide' is generally accepted as including conventional insecticides, fungicides, herbicides, rodenticides and all similar products either employed in agriculture or used for the safe storage of foodstuffs of all types. Pesticides, when dispersed in a given concentration, are obviously deliberately designed to be toxic to some form of animal, fungal or vegetable life, and the main object of all controls, whether statutory or voluntary, is to provide an assurance that the risk to the human consumer of pesticide-contaminated foodstuffs is no more than would be tolerated under the present Pure Food Acts.

## GUIDANCE TO USERS OF PESTICIDES

Although there are no recorded cases of food poisoning in this country due to pesticide residues, some of the pesticides themselves in concentrated form are highly poisonous materials, and the Ministry has given detailed guidance to agricultural users. Any person who exposed his bare skin to strong solutions of nicotine, pentachlorophenol salts or solutions of parathion would be accepting a risk that could well prove fatal. An enormous dilution factor exists between the crop sprayer and the crop consumer, and provided the Ministry's recommendations are rigidly observed, the ultimate concentration of pesticide residue in the crop is at an

innocuous limit. A detailed survey of the toxicity of pesticides has been published by Barnes<sup>3</sup> who draws the general conclusion that the health hazards to communities are of negligible order if pesticides are used intelligently.

It is generally appreciated that poisonous substances are present in minute harmless concentrations in some natural foodstuffs.<sup>4</sup> The alkaloid, solanine, is found in small amounts in potatoes; arsenical compounds and various alkaloids are found in some mushroom-type fungi; cyanogen compounds exist in almonds; and even wheat is occasionally subject to contamination by ergot. The criterion of harmlessness is mainly dependent on the concentration of toxic material present, although in some instances the cumulative effect of a small, continual intake of a poisonous material has to be critically considered. Some toxic materials also call for special examination because of some specific property, *e.g.* the carcinogenic character of a substance, or the cumulative effect of an ingested, strongly retained chemical on bodily health. In considering foodstuffs containing traces of pesticide, the frequency and magnitude of consumption of a defined product should also play some part in defining any acceptable tolerance level. It would not be logical to class a staple article of diet such as milk or bread with the infrequently eaten Brazil nut or pineapple.

## PERMITTED MAXIMUM CONCENTRATIONS

In the United Kingdom, only arsenic residues are covered by statutory legislation, the permitted maximum concentration being 1 part per million in certain foodstuffs, although slightly higher proportions are permitted in other specified cases.

Recommendations of the Food and Agriculture Organization of the United Nations and the World Health Organization have led to the introduction, by the United States of America, New Zealand, the Union of South Africa and some other countries of statutory legislation which limits the permitted maximum amounts of specific pesticides on a defined variety of foodstuffs. Highly toxic compounds such as endrin, dieldrin, parathion or tetraethyl pyrophosphate are usually allotted a zero tolerance, although they are for some foods accepted at concentration levels of only fractions of one part per million. 'Zero Tolerance' is a difficult function to define, and the average chemist would probably consider this trite phrase to be synonymous with 'chemically undetectable.' Much importance is thus attached to the method employed for analysis.

A considerable amount of toxicological information is accumulating on the effect of various pesticides on rats, rabbits, sheep, cows and so on,<sup>5</sup> and frequently the oral LD<sub>50</sub> figure\* for rats is accepted as giving some indication of relative toxicity. The U.S.A. food tolerances do not, however, appear to be based entirely on the LD<sub>50</sub> toxicity ratings but on the lowest practicable levels found on fruit, meat, grain and so forth, which are consistent with the intelligent use of toxic sprays for the elimination of agricultural or animal pests, and which yield residue levels that are regarded as innocuous.

In the United Kingdom, no comparable legislation has been introduced to define in a quantitative fashion the tolerable concentrations of pesticide residues in foodstuffs, but it must be borne in mind that the Food and Drugs Acts give protection to the consumer in that 'Material injurious to Health of Persons' must be excluded from all foods. In 1942, the Ministry of Agriculture, Fisheries and Food, in conjunction with the Department of Agriculture for Scotland, introduced a voluntary scheme which gave guidance to the grower in the purchase of materials for crop protection.

#### EXTENSION OF VOLUNTARY SCHEME

More recently, the voluntary scheme has been extended<sup>6</sup> and an Agricultural Chemicals Approval Organization (A.C.A.O.) has been set up which will, on the basis of scientific evidence relating to their products supplied by industrial pesticide manufacturers, consider the granting of formal Ministry approval for the use of those particular products in agriculture. Applications for such certificates of approval must be made to the Director, Plant Pathology Laboratory, Harpenden, a registration fee being payable.

The Working Parties set up under Sir Solly Zuckermann in 1953 and 1954 examined in some detail the general questions of 'Residues in Food,'<sup>7</sup> and 'Risks to Wild Life,'<sup>8</sup> and made appropriate recommendations. Emphasis was given to the need for analytical control, and it was suggested that the Laboratory of the Government Chemist should seek methods for the determination of micro quantities of toxic residues in food. The Interdepartmental Advisory Committee on Poisonous Substances used in Agriculture and Food Storage implemented action with the Government Chemist on this matter, and a research team was established in the Laboratory to develop quantitative methods for the analysis of pesticide residues on a variety of foodstuffs and on experimentally sprayed crops. Such survey work enables the Advisory Committee and its Scientific Sub-committee to base their general recommendations on sound, independent chemical evidence, and is being extended.

The analytical problem is complicated by the fact that over 100 pesticides of complex chemical character

could well be employed for specific applications covering a wide spectrum of insect life. Even the positive, qualitative identification of a pesticide residue presents a problem bristling with difficulties.

In May, 1956, the Ministry of Health sought the advice of this Laboratory in connection with a mystifying outbreak of food poisoning at Pontardawe, South Wales,<sup>9</sup> when 59 people were medically treated for dizziness and convulsions after eating bread made from accidentally contaminated flour. Chemical, chromatographic and infra-red analyses indicated the presence in the flour of the insecticide 'endrin' (1,2,3,4,10,10-hexachloro-6:7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-*exo*-1:4-*exo*-5,8-dimethanonaphthalene). This poison had found its way into sacks of flour from a railway waggon in which a package containing endrin had previously broken open. In this particular instance some samples of the flour contained as much as 5,500 p.p.m. of pesticide, whereas the normal concentrations of various pesticide residues in fruit, meat and so on from agricultural sources is usually about 1 p.p.m. or less.

#### SPECIFIC METHODS OF ANALYSIS

The analytical problems attending the quantitative determination of minute amounts of this nature are immediately apparent and are attracting world-wide chemical interest. A Committee has been set up jointly by the Scientific Sub-committee of the Interdepartmental Advisory Committee on Poisonous Substances used in Agriculture and Food Storage, the Analytical Methods Committee of the Society for Analytical Chemistry and the Association of British Manufacturers of Agricultural Chemicals to examine and recommend specific methods of analysis.

Some effort in the Laboratory has been directed towards the development of standard methods for the estimation of *known* pesticides applied to crops, *e.g.* DDT,<sup>10</sup> BHC<sup>11</sup> and dimefox.<sup>12</sup> When the nature of the pesticide used is not known, its identity may sometimes be inferred from the nature of the crop, *e.g.* an organo-mercurial fungicide such as phenyl mercuric salicylate is normally sprayed as an aerosol on glass-house tomatoes; some authorities consider minute residues of this substance to be undesirable.<sup>13</sup> Details of one method for mercury, involving extraction with dithizone followed by a spectrophotometric finish, have already been published.<sup>14</sup> A report on work for the Advisory Committee on the volatility and toxic hazards of some related mercurials is also available.<sup>15</sup>

The extraction of pesticide residues from plant pulp is frequently effected by means of polar organic solvents, such as acetonitrile or dichloromethane, and subjecting the extract to a 'clean-up' process. There are also specific methods of analysis for some of the pesticides, *e.g.* dieldrin and DDT.

Parathion is usually determined by conversion to the amine, then diazotizing and coupling to form a dye

\* The LD<sub>50</sub> figure is the dosage that leads, under specified conditions, to the death of 50 per cent of the test animals.

with a distinctive absorption spectrum. Polarographic methods may also have an application here, as with other reducible compounds. A specific method for DDT depends on initial nitration to the tetranitro-compound and then inducing a blue colour by addition of alcoholic alkali, the intensity of the colour being determined spectrophotometrically at 600 millimicrons.

Analytical complications always exist when some 'indicator' groups such as phosphate or fluoride occur naturally, and it would obviously be completely illogical to accept the micro-determination of such radicals as an indication of the respective concentrations of tetra-ethyl orthophosphate or of fluoroacetamide present as pesticide residues.<sup>16</sup> Fortunately, it is often found possible to separate the pesticide from the naturally occurring radical by a combination of the techniques of solvent extraction and of column or paper chromatography, procedures which assist materially in the qualitative identification and the quantitative determination of unknown pesticides.

Some pesticides contain sulphur as well as chlorine or phosphorus, and some work is at present in progress to establish whether micro-determination of the ratios of these elements will assist in the positive identification of the unknown pesticides present.

#### DEVELOPMENT OF TECHNIQUES

The new technique of gas-liquid chromatography<sup>17</sup> affords a powerful method for the identification of some herbicides, *e.g.* the chloromethylphenoxypropionic acid composites, and will undoubtedly have much future application.

In contrast to the organo-chlorine pesticides, many of the systemic organo-phosphorus compounds recently introduced are water-soluble, and undergo translocation to the roots and foliage of the plant, thus providing a toxic meal for the insects that absorb the plant juices. Some of these phosphorus compounds, *e.g.* phosphamidon (2-chloro-2-diethyl carbamoyl-1-methylvinyl dimethyl phosphate) or parathion (diethyl-*p*-nitrophenyl phosphorothionate) are highly toxic, but are fortunately hydrolysed or oxidized fairly rapidly to produce metabolites of lower toxicity. The poisoning effects produced are due mainly to the inhibition of the cholinesterase enzyme with consequent accumulation of acetyl choline in the tissues. With the human subject, quantitative determination of this enzyme in the blood affords an indication of the danger level produced by the assimilation of the poisonous insecticide.<sup>18</sup>

In the laboratory assessment of pesticide toxicity, acetyl choline, in a suitable buffer solution, is hydrolysed by the cholinesterase of a standard blood plasma to give acetic acid, and the pH change is followed. The results obtained from aliquots of pure plasma are compared with those from plasma solutions to which known quantities of organo-phosphorus insecticides have been added. Metcalfe<sup>19</sup> has developed a variant of this

method whereby the change in acetyl choline content is quantitatively determined.

The technique of biological assay<sup>20</sup> provides a powerful alternative to the chemical method. The pesticide residue obtained, with or without chemical 'clean-up,' is exposed under defined conditions to a known insect population of a suitable species, and the observed mortalities are compared with those resulting from known concentrations of the toxic chemical in question. The method merits much future study, and a comprehensive review of its international applications has been recently published by Needham.<sup>21</sup>

Very considerable public and parliamentary interest continues to be shown in the varying problems associated with the use of pesticides either for crop protection, as agents for dealing with infestation or as rodenticides, fungicides or herbicides.

An interesting recent investigation<sup>22</sup> comments on the contamination of flour in various British mills as a result of treating machinery, bins and the like with insecticidal lacquers containing dieldrin or endrin. Values as high as 300 p.p.m. of pesticide residues were found in flour samples which had been in direct contact with the lacquer, and it was recommended that such protective treatments be discouraged because of the toxic risk.

#### GUIDANCE ON TOLERANCE FIGURES

Although no tolerance figures having British Governmental approval have been published or tabulated for the many pesticides in commercial use, it would now appear desirable to give some quantitative guidance to food analysts regarding the levels of pesticide residues that could be regarded as innocuous in foodstuffs. It may be that, in many instances, enough chemical and toxicological data exist for the assessment of such tolerance values, because the Ministry of Agriculture's present notification scheme takes such factors into consideration in its criteria for the acceptance of commercial pesticides. Under this system, however, the control of residues in crops depends essentially on the user following the rigid code of practice agreed with the Ministry. The food analyst must find it difficult to exert any form of control at present for, apart from the tolerance data provided by legislation in foreign countries, he has no authoritative domestic toxicological tables to guide him in making a decision on the acceptability of any food which may be contaminated with minute amounts of pesticide residues.

It must, however, be borne in mind that too strict a legislative approach could not only deprive agricultural interests of the immense benefits which have followed the use of these toxic chemicals, but it could also have the most adverse influence on international trade in wines, fruit products and food materials of all kinds. Nevertheless, some form of control by qualified food chemists could only constitute an additional safeguard

to the consumer and obviously should not embarrass the intelligent user of pesticides. Complete inspection of a nation's food supply would be impossible to organize, but this need not prevent the tabulation of toxicological tolerances to be used as a basis when analysing selected crops, as is done in the U.S.A.

The rapid progress of atomic, chemical and biological science is continually presenting mankind with problems and issues that can only be solved by a realistic scientific approach, coupled with logical, well-balanced argument and thought. Some difficulties still exist, but the major problems affecting the safe use of pesticides on growing crops, on farm animals or as seed dressings have, in most cases, reached a satisfactory solution. Research by chemical manufacturers to produce equally efficacious but more innocuous materials should, however, be consistently encouraged, and there are indications that in the specific case of herbicides, this aim of producing non-poisonous materials has already been almost accomplished.

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## Book Reviews

THE EDGE OF OBJECTIVITY. AN ESSAY IN THE HISTORY OF SCIENTIFIC IDEAS. C. C. Gillispie. Pp. viii + 562. Princeton: University Press; London: Oxford University Press, 1960. 42s.

Chemists should find this admirably clear and elegant survey of the sciences extremely interesting. The author's method is to treat the subject in periods determined by prevailing general views on the nature of the universe. In each period he selects his chief characters by the criterion of how far they succeeded in making their science objective—and by this he means the invention of methods and techniques which enabled results to be produced whose form and content were independent of human wishes and desires. A great virtue in the author's treatment is that he manages to make clear how objectivity in this sense was achieved by, for instance, Newton, Lavoisier and Darwin, within the intellectual climates of their times.

The development of an objective chemistry by Lavoisier is described in chapter 6. The author sees Lavoisier's achievement as an ambiguous one. With extreme clarity of intention, Lavoisier adapted the gravimetric methods of Black to the discoveries of Priestley and Cavendish, and so resolved the problem of the nature of combustion. The definitiveness of Lavoisier's experimental attack and the careful progressiveness of his experiments are beautifully described in this chapter, so that we come to see the inevitability of the Memoir of 1785 in which phlogiston is excluded from chemistry, for there is nothing left for it to explain. Thus the chemistry of principles, of flux, came to an end. The object of chemistry became 'the positive combinations and separations of materials rather than qualities, its events reactions rather than fluxes, coctions and processes' (p. 231). Lavoisier's systematic chemistry, on the other hand, remained taxonomic. As Professor Gillispie puts it, in discussing Lavoisier's chemical symbolism, 'what he was numbering were the forms of matter, not its particles.'

The book begins with a sketch of Renaissance science and then begins to develop its main themes in detail. Throughout the discussion the narrative moves backwards and forwards between France and England, geographical location serving as an index of philosophical persuasion. In the three centuries covered by Professor Gillispie's narrative one is made aware again and again of the contrast between the fruitful empiricism of the English tradition and the elegant orderliness of the French, and the progress of science as a successive capping of one by the other. Embedded in the larger sweeps of history are some first-rate accounts of individuals. Two particularly good ones are those of Faraday and Fresnel, but there are many others.

This is an excellent book, stimulating for someone

**I.C.I. Science Medal.**—Miss Valerie Brown, aged 21, a laboratory assistant in the services works analytical section, Wilton, has been awarded the I.C.I. Science Medal—a silver medal presented annually to a student of outstanding ability following a course in chemistry, physics or metallurgy. Miss Brown, who is taking a 'sandwich' course at the Constantine Technical College, Middlesbrough, is studying for Part II of the Graduate Membership Examination.

just beginning to take an interest in the history of scientific thought, and sufficiently scholarly in its material and conclusions to be worth reading by the specialist, too.

R. HARRÉ

A HISTORY OF PLATINUM. FROM THE EARLIEST TIMES TO THE EIGHTEEN-EIGHTIES. D. McDonald. Pp. 254. London: Johnson, Matthey & Co. Ltd, 1960. 35s.

Although platinum was found in Central America early in the sixteenth century its serious history does not begin until the metal was introduced into Europe in the 1740s. Its apparent infusibility, its resistance to corrosion, as well as its novelty, immediately aroused the curiosity of leading chemists in England, France, Sweden and Germany. They showed that native platinum was impure, that it was soluble in *aqua regia*, that it could be melted when very high temperatures were available and that it could when hot be autogenously welded. On the purely chemical side they developed methods for purifying the native material and they both recognized and exploited its alloy-forming capacities. Eventually they brought to light the other members of the platinum group, separating them from platinum and from each other. All these discoveries, spread over a century, are woven into a fascinating story by Mr McDonald, along with particulars of the scientists principally concerned.

The melting of platinum, its malleability and its weldability were established by the 1750s. They 'were responsible for the start of the fabrication of platinum for commercial uses and underlie the industry that gradually grew up during the next hundred years,' developments which are fully considered in this book. Goldsmiths led the way by making ornaments, personal jewellery and many beautiful pieces of plate from platinum, and some of the more successful devised improved methods of purification, using any information the chemists could provide. Concurrently, those chemists who were also adept in the requisite techniques made laboratory apparatus in platinum. The growth of laboratory ware into industrial equipment naturally ensued and by the middle of the nineteenth century quite large pieces of chemical plant were being produced. Technologists were by then in the lead but throughout they leaned heavily on the work of chemists in many European countries.

Soundly documented and well illustrated, the history of both the science and the technology of platinum is admirably related by Mr McDonald. He freely quotes from the many available sources but does not overload his narrative, his book reading very pleasantly. It is sad that for adequate reasons this detailed account had to end at 1890; for the period covered it is completely authoritative and is not likely to be superseded for a very long time.

LESLIE AITCHISON

NAME INDEX OF ORGANIC REACTIONS. J. E. Gowan and T. S. Wheeler. Pp. vii + 293. London: Longmans, Green & Co. Ltd, 1961. 50s.

This book is the second edition of a much smaller one published by the Society of Chemical Industry in 1950. The present work has been rewritten and expanded to include 739 named reactions (these include named rearrangements). The literature of organic chemistry is full of reactions named after chemists who discovered or developed them. This has resulted in a 'shorthand' way of referring to specific reactions, but there is divided opinion as to whether this is a desirable thing. Be that as it may, the system becomes frustrating unless the reader is familiar with the 'name reaction' or has a ready means of finding out what it is. It is the function of this book to supply this information, and it can be said immediately that the aims of the authors have been achieved in a most admirable fashion. Each name reaction is concisely and clearly described, then illustrated by equations (general or specific) and finally a list of references is given. These references are very comprehensive, and include original papers, review articles and books (generally monographs). The last two will be useful to those who wish to find authoritative general accounts of the various reactions.

The reactions are described in alphabetical order (and hence easily located), and the numerous cross-references given are an added advantage in relating similar reactions. There are two indexes, the Type of Reaction Index and the General Index. The former is particularly useful in that it will enable the reader to pin-point various methods of carrying out a particular type of reaction; for example under the heading cyclization there are 36 entries and under oxidation 37. The General Index is of more help when dealing with a particular compound or type of compound.

This book will be of great value to anyone who reads the literature of organic chemistry, and this applies to both students and research workers. It is very well printed and produced, and as a whole contains a wealth of information on organic chemistry; it is a tribute to the industry of the two authors. The popularity of the first edition is a proof of the necessity for such a book, and there is no doubt that this enlarged second edition will be even more successful.

I. L. FINAR

THE CHEMISTRY OF NUCLEIC ACIDS. D. O. Jordan. Pp. ix + 358. London: Butterworth & Co. (Publishers) Ltd, 1960. 60s.

The nucleic acids have attracted the attention of chemists and biologists for many years, but progress towards an understanding of the true nature and function of these natural products was inevitably slow, owing to their complexity. Often experimental methods were not developed to a stage that permitted the solution of an outstanding problem. Since the end of the

second world war interest in these substances has been intense and, as is well known, remarkable strides have been made towards a better understanding of nucleic acids and nucleoproteins. A particularly fascinating feature of this development is the way in which results from various branches of science have been integrated and systematized. To quote the author: 'Our present knowledge of the structure and function of the nucleic acids has been accumulated by means of studies involving a wide variety of different scientific disciplines ranging from physics, through chemistry and biochemistry to biology and genetics.'

To write a comprehensive book covering all these aspects is clearly impossible. In fact, several volumes would be required and the work would be beyond the compass of any one author. In this book Professor Jordan has concentrated on the chemical structure of nucleic acids, and within these terms of reference he has produced an excellent text. He is a well-known expert on his subject, and has made important contributions to the physical chemistry of nucleic acids. As might be expected, he deals with this topic exceptionally well. However, he gives an extremely balanced account of the subject and deals fully with the organic chemistry of nucleic acids. The term 'structure' is used in its widest sense, and so, in addition to the detailed chemical architecture of the nucleic acid molecule, other facets of the subject have also been described. For example, the isolation and fractionation of nucleic acids, the heterogeneity brought about by different sequences of nucleotides, by different nucleotide components and by different molecular size are considered. There is a short final chapter on the implication of the helical structure on the replication of nucleic acids. The chapters are well illustrated with figures, formulae and tables of results, and eight photographic plates are included. At the end of each chapter there is an extensive list of references, and an author and subject index at the end of the book. The printing and binding are of good standard.

The author must be congratulated on his book. He has reviewed a wealth of material in a concise and readable manner, and has produced a very worthwhile volume which at the published price can be regarded as a good bargain. It is to be recommended not only to chemists but to all interested in nucleic acids.

W. G. OVEREND

PROPERTIES AND STRUCTURE OF POLYMERS. A. V. Tobolsky. Pp. ix + 331. New York: John Wiley & Sons Inc.; London: John Wiley & Sons Ltd, 1960. 116s., \$14.50.

The relationship between chemical structure and physical properties of polymers is a subject of absorbing interest to the pure scientist and the technologist alike. Very few books deal exclusively with this topic, and so a new one written by a physical chemist with wide

experience in the field is bound to attract a good deal of attention. The author warns us at the outset that his choice of material is (not unnaturally) guided by his own experience, and the publishers hasten to add that the selection is wide enough to afford a comprehensive treatment of the field. Unfortunately this last statement is seriously to be doubted.

The first two chapters give a brief summary of elastic and visco-elastic phenomena observed in simple compounds and polymers. Useful tables of melting and glass transition temperatures, coefficients of expansion and so on are included, and the appendixes present some of the basic principles in detail. In chapter 3, the reader is plunged into a phenomenological analysis of visco-elasticity and in the following chapter it is applied to most of Tobolsky's data on stress relaxation. Creep and birefringence studies are also mentioned, but dielectric and mechanical loss techniques and nuclear magnetic resonance spectroscopy are dismissed in one page. Furthermore, little attention is paid to the attempts to produce a specific molecular theory of relaxation, and even qualitative correlations between properties and structure are not clearly drawn. Chapter 5 includes a very good review of chemical stress relaxation and the final chapter surveys recent work on monomer-polymer equilibria.

This is the gospel of polymer science according to Tobolsky and will, no doubt, be useful to readers with similar interests. The non-specialist must be careful to recognize its limitations. Inevitably, the book will be compared with Treloar's *Physics of Rubber Elasticity*. In my opinion the latter contains a better discussion of the equilibrium properties and a better balanced—though less detailed—account of the dynamic properties of polymers.

The standard of the technical production is high and so is the price.

G. ALLEN

SIZE AND SHAPE CHANGES OF CONTRACTILE POLYMERS. CONVERSION OF CHEMICAL INTO MECHANICAL ENERGY. (Proceedings of Seminars held at University College, London). Edited by A. Wassermann. Pp. viii + 118. Oxford: Pergamon Press, 1960. 35s.

A mechano-chemical system is, broadly, one capable of transforming chemical energy (including redox processes) into mechanical work; related teino- or tensio-chemical systems are exemplified by a demonstration (with preparative details given) of a polyacrylate film which lifts and lowers a weight on being treated with hydrochloric acid and sodium hydroxide alternately. This also typifies much of the matter of the book. Originating 10 years ago from interest in muscle activity, this branch of polymer study has attracted groups of physical chemists in Basel, Belgium, Israel and London, besides workers on X-ray diffraction in Leeds. Recent

ideas of these schools are presented in five papers, of which one is mostly thermodynamic theory. A sixth contribution is a masterly essay by C. A. Vernon, of University College, on the high-energy phosphate bond concept. This refers to metabolism and not to the new mechano-corpus of non-biological material; but it draws on the purest essence of chemistry. To suppose that metabolic reactions are energy-linked (says Vernon) will 'add nothing to the understanding of biochemical processes.'

This may suggest that the book is well worth buying by specialists and anyone looking for a striking conversazione exhibit.

A disjunct attitude to inseparable physico-chemical manifestations is notable in the first five papers. Ions in polyelectrolytes get detailed attention; theoretical treatments and speculations extend to sodium chloride, buffers and other electrolytes in true solution. Yet solutes are defined only in molarities; pH (as concentration of  $H^+$ ) is the only ionic parameter discussed for environmental fluids. Awareness of relations between ions of solvent and solute is incomplete; this affects, for example, interpretation of quoted measurements (by S. E. Bresler, of Leningrad) in dioxan solution 'at several values of pH.' Dioxan, like water, has a unique pH-value; mechano-chemistry could apparently benefit from an infusion of elementary physical chemistry. Would C. A. Vernon oblige with some further constructive debunking?

HUGH NICOL

PRACTICAL ORGANIC CHEMISTRY. Fourth Edition.  
F. G. Mann and B. C. Saunders. Pp. xix + 585.  
Harlow: Longmans, Green & Co. Ltd, 1960. 25s.

For many years 'Mann and Saunders' has been recognized as an established textbook of practical organic chemistry, and its usefulness and popularity will undoubtedly be increased by this new and extensively revised edition.

The present volume, like the third (1952) edition, is divided into five parts dealing with methods and manipulation, preparations, reactions and identification of organic compounds, quantitative analysis and simple enzyme reactions. Over 100 pages of new material have been added, and yet the price remains within the reach of all students.

The new edition differs from the previous edition in two major respects. Firstly, special emphasis has been given to semi-micro techniques and their application to the preparation, separation, analysis and molecular-weight determination of a wide range of organic compounds. The preparation of some 40 compounds on a semi-micro scale is described in detail, and in addition specific directions for the preparation of many classes of crystalline derivatives are given. As a result of this, the tables of melting points have been increased correspondingly.

Secondly, many additional reactions are now illustrated by preparations; these include *inter alia* reduction by lithium aluminium hydride, oxidation by selenium dioxide and by periodate, the Michael, Hoesch, Leuckart and other reactions, and the Pinacol-Pinacolone and Beckmann rearrangements. A considerable proportion of the standard synthetic reactions are now included.

Other changes include the introduction of sections dealing with adsorption, paper and ion-exchange chromatography, the semi-micro analysis of halogens, and extensive revision of Part III (reactions and identification) to enable students to analyse a wider range of compounds. The new edition thus fully meets the requirements of students working for Honours or Special Degrees.

Throughout, the text retains its characteristic blend of the theoretical and practical aspects of organic chemistry and it is clear that all experimental details have been carefully checked, so that the minimum of materials and the simplest possible apparatus are required. The book is well produced, and can be unreservedly recommended.

D. J. MANNERS

SPOT TESTS IN ORGANIC ANALYSIS. Sixth Edition.  
F. Feigl. Translated by R. E. Oesper. Pp. xx + 675. Amsterdam: Elsevier Publishing Company; London: D. Van Nostrand Company Ltd, 1960. 65s.

One of the most outstanding features of Feigl's books on spot-testing is the large amount of his original research work that is published for the first time within their covers. This unconventional approach to publication is particularly evident in the sixth edition, and adds a peculiar interest to the text. As usual, the book contains a large number of new procedures, but in my opinion by far the most significant feature is the inclusion of the new dry tests based on hydrolytic and ammonolytic cleavage, displacement, condensation and oxidation-reduction reactions produced by sintering compounds with the appropriate reagents. Thus in the third chapter alone such new procedures are described for the preliminary detection of (a) aromatic compounds containing oxygen, (b) compounds which split off water or ammonia when heated to  $190^\circ$ , (c) compounds which split off water at  $180^\circ$  and (d) compounds which yield ammonia when pyrolysed (evolution of oxamide by heating with thiobarbituric acid). The growing interest amongst organic chemists in the analysis of characteristic functional groups is also reflected within these pages. This section, despite some pruning, has increased by 40 per cent and includes *inter alia* new tests of high sensitivity for compounds containing  $C\equiv N$  and  $C=N$  groups, polyhydroxybenzenes, stibonic acids,  $\beta$ -hydroxyethylamines, 7-dehydrosterols, vinyl compounds and phenoxy compounds. A similar expansion has taken place in the sections for individual compounds

and practical applications in the testing of industrial materials. Within this latter category new tests have been described for many substances, *e.g.* adhesives containing protein, ascorbic acid in vegetables and fruit juices, vitamins B<sub>1</sub> and B<sub>6</sub>, melamine, styrene and epoxy resins, barbiturates, helicin, hippuran, chloroform and carbon tetrachloride in presence of each other (by pyrolytic cleavage) and so on.

This edition is larger than the fifth by nearly 60 pages, despite the elimination of many procedures from the previous edition. In this respect the reader must be particularly grateful to the author for selecting the older material, comparing it with the new and retaining only the best of each. Beyond any argument, no one is better qualified to judge such issues. This new book, like its author, is unquestionably a giant on the analytical scene.

T. S. WEST

DEMINERALIZATION BY ELECTRODIALYSIS. Edited by J. R. Wilson. Pp. xv + 378. London: Butterworths Scientific Publications, 1960. 60s.

Some six years ago the South African Council for Scientific and Industrial Research started an extensive investigation of the electrodialytic demineralization of brackish water. One outcome has been the construction of a large-scale electrodialysis plant, and the team of chemists, chemical engineers and engineers concerned with this project have, as a consequence, acquired a considerable knowledge of the problems involved. Their combined knowledge and experience which is set out in this book will be of value not only to those interested in the treatment of brackish water, but also to those concerned with the large-scale use of ion-exchange membrane cells.

The first three chapters, which take up nearly half the book, are devoted to a review of the electrodialysis process itself and to the preparation and properties of ion-selective membranes. Those interested in the basic principles and the general applications of electrodialysis will find these chapters particularly valuable, but they would be ill-advised to neglect the later chapters, which are concerned with the practical problems of the preparation of membranes for large-scale use, with the design of the demineralization plant and the evaluation of pilot-plant experiments. Some of the problems met with in the project are undoubtedly peculiar to the treatment of brackish waters, but many will be found to apply to most applications of electrodialysis.

A clear and uniform style of presentation has been achieved, and the reader is not bothered by abrupt changes in the style of writing, which so often characterize books written by a large group of collaborators. Good use is made of diagrams, which are clear and easy to follow, and the bibliography is excellent. Research and development chemists and chemical engineers will find this a most useful book.

J. E. SALMON

WAVE MECHANICS AND VALENCY. (Methuen's Monographs on Chemical Subjects.) J. W. Linnett. Pp. xii + 184. London: Methuen & Co. Ltd; New York: John Wiley & Sons Inc., 1960. 18s.

Accuracy and intelligibility have been rarely in evidence in many recent publications on elementary quantum chemistry, and this thoroughly reliable book by a versatile and distinguished author is most welcome. It has been written in the conviction that 'there are undoubtedly great dangers in the employment of purely qualitative or pictorial wave mechanics,' and it is intended for those chemists (may their tribes decrease!) whose mathematical attainments do not go beyond G.C.E. Mathematics for Science.

Dr Linnett discusses in turn exact solutions of the Schrödinger equation for some one-particle systems (pp. 48); the mathematical basis of approximate solutions (pp. 11); wave functions for two-electron systems (pp. 54); and various aspects of the quantum chemistry of a miscellany of many-electron systems (pp. 60). No exercises are provided. By comparison with the fine chapters that follow, the section on perturbation and variation methods seems inadequate, the wave-mechanical mean-value postulate being introduced almost furtively; but in other respects the book is very well balanced. The presentation is clear; but it might have been more elegant if the author had adopted the customary Hartree units and had been less restrained in the use of abbreviated notation. (The Hamiltonian operator first appears as *H* on p. 58.)

Although this book is rather too terse to serve as a simple introduction to quantum-chemical techniques, and is certainly not to be recommended to the faint-hearted; it should prove exceedingly helpful to those who have already mastered the elements of valency theory (at the level, say, of Coulson's *Valence*), and who wish to sharpen their perception without embarking on an unduly extensive course of study. Indeed, there are some chapters (notably those on two-electron systems) which even the most sophisticated quantum chemist will read with pleasure and enlightenment. Unlike *Valence*, Dr Linnett's book will not make hosts of converts; but it will preach very effectively to the converted.

The printers have worked bravely and accurately in face of difficulties imposed by an awkward format; but the layout could have been improved considerably by skilful editing. There is far too much needless dislocation of the line-spacing, the setting of even a simple term like  $\exp(-Z'r/\rho)$  repeatedly engendering an ugly and extravagant display of typographical virtuosity. Some of the diagrams are badly placed, and figure 5 is surprisingly off scale. In many ways the limited space available in a Methuen monograph has not been used to the best advantage: for example, while a few inches are saved by the vexatious omission of literature

references, two pages are squandered on a purposeless table of illustrations. It is a pity that the publisher's editorial staff have not shown, in their sphere, the powers of discernment so refreshingly characteristic of the author.

E. THEAL STEWART

#### ADVANCES IN FLUORINE CHEMISTRY. VOLUME I.

Edited by M. Stacey, J. C. Tatlow and A. G. Sharpe. Pp. vii + 203. London: Butterworths Scientific Publications, 1960. 45s.

Professor Stacey says in his introduction: 'Fluorine chemistry has reached an exciting stage and shows great promise for the future'; clearly, *Advances in Fluorine Chemistry* is a series which will help this promise to be realized. It cannot fail to stimulate greater interest and effort in the field. All the ramifications of the subject are developing so rapidly that a scheme which will produce review articles at moderately-spaced intervals is welcome. The authority of the editors and their own research contributions are guarantees that material will be published as soon as it is sufficiently advanced to have general significance.

In this first volume, Professor Musgrave deals with the preparation of the halogen fluorides and their uses in inorganic chemistry, Dr A. G. Sharpe with the transition-metal fluorides and their complexes, and Dr D. W. A. Sharp with the fluoroboric acids and their derivatives. Dr J. Burdon and Professor Tatlow describe the electrochemical synthesis of fluoro-organic compounds, and Professors Stacey and Tatlow the exhaustive fluorination of organic compounds by high-valency metallic fluorides. The choice offered to the reader must provide something of interest to all concerned with fluorine. None of the subjects has been reviewed recently, and every one of them presents the possibility of much rewarding research. To see them together in one volume emphasizes the artificiality of some traditional divisions and makes for a cross-fertilization from which nothing but good can come.

The treatment meets the needs of the general reader by providing adequate introductions to the several topics, and those of the specialists by being up to date and documented. Although the style and, occasionally, the terminology remain individual to the authors, this is no disadvantage because the text, whether handling theory or practice, is always clear and concise. The illustrations and figures are helpful, even if the one on p. 11 halts the reader a moment.

Many of the compounds and reactions which are discussed were either unknown or chemical curiosities a decade ago, and most of the references—conveniently appended to their own articles—belong to this period. It is also true to say that the special place of fluorine among the halogens and the functioning of the fluorine atom in both inorganic and organic environments have

been vastly better recognized and understood during the same time. This is especially brought out in the second, third and last articles in this volume.

The book is printed on good paper and nicely bound. It has an adequate index intended to supplement the list of contents preceding the individual articles. The series is off to a good start with this reasonably priced, attractive volume, and all interested in fluorine will look forward to the next.

P. L. ROBINSON

#### PHYSICO-CHEMICAL MEASUREMENTS AT HIGH TEMPERATURES.

Edited by J. O'M. Bockris, J. L. White and J. D. Mackenzie. Pp. viii + 394. London: Butterworths Scientific Publications; New York: Academic Press Inc., 1959. 75s.

It is more than 50 years since the last comprehensive text on molten salts appeared, and it is timely and in keeping with the upsurge of new interest in the field that this fresh appraisal should be published. Physico-chemical measurements at high temperatures, that is between 100° and 2,000°, are important for two reasons. Firstly, the results are of intrinsic interest in describing new states of matter; secondly, they are essential to the understanding and development of some of the newer technologies, such as nuclear power, rocket propulsion and fuel cells, as well as of many of the older technologies such as metal-winning and glass making. Considerable attention is being paid in the U.S.A. and the U.S.S.R. to a wide range of high-temperature investigations, although elsewhere, and especially in the U.K., there is relatively little of this type of research being carried out.

This book then is very welcome and will be invaluable to anyone embarking on high-temperature measurements. It has been written by 16 enthusiastic research workers who have pooled their considerable experience of a field still only sparsely populated with facts. The first 100 pages deal with the general techniques of high-temperature measurements (Margrave, Motzfeld, Livey, Murray). The stability of constructional materials is rightly stressed as the limiting factor in many experiments, and the behaviour of many metals and refractories in contact with molten chlorides, silicates, oxides and so on has been carefully recorded. Chapters have been contributed on the experimental study of phase equilibria (Schairer), chemical equilibria (Richardson, Alcock), calorimetry (Kubaschewski, Dench), density (White), surface tension (Kozakevitch), vapour pressure (Margrave), electrochemical measurements (Tomlinson), light absorption and scattering (Bues), ultrasonics (Richards, Bloom), diffusivity (Yang, Simnad) and viscosity (Mackenzie). Finally, there are several valuable appendices on special aspects of the experimental technique. In each section the relevant theoretical background is presented, and there is an extensive bibliography.

In such a wealth of information, there is room for criticism of certain of the experiments described, of the viewpoints taken and even of the results. But this would be cheese-paring and inappropriate to a book that has dealt authoritatively and comprehensively with this important branch of physical chemistry.

The authors are to be commended not only for their perseverance in the face of unusually difficult experimental conditions but also for so clearly lighting the path for others to follow.

G. J. HILLS

EXPLOSIONS, DETONATIONS, FLAMMABILITY AND IGNITION. Part I, S. S. Penner. Part II, B. P. Mullins. Pp. xi + 287. London: Pergamon Press Ltd, 1959. 70s.

Combustion is old in practice and abstruse in mechanism, and a deep division has separated practical development from fundamental understanding. In the last few years the tempo of the work on bridging this gap has quickened greatly. Nevertheless, it can still be said with justification, as Dr Mullins does in the Introduction to Part II of this book, that, while basic theoretical treatments of combustion phenomena can generally yield quantitative conclusions that are correct only in order of magnitude, semi-empirical treatments give results of practical utility. Perhaps the most usual reason for this difference is that the theoretical model employed lacks realism, either from choice or from necessity.

It is therefore in hopeful anticipation that one takes up this book after learning from the publisher's note that 'the same material has been discussed by the two authors from entirely different but complementary viewpoints, the one analytical and the other semi-empirical and practical.' Disappointment is in store, however, for even in so far as the authors discuss the same material—which they do by no means consistently—they make no attempt to achieve a synthesis of their contrasted points of view. In short, we have here two separate books within one cover.

In Part I, Professor Penner considers the theory of chain reactions and explosion limits, detonation in gases, limits of flame propagation and flame quenching, ignition by local sources and the burning of droplets. In Part II, Dr Mullins deals with flammability limits in their many aspects, spark and spontaneous ignition, combustion processes in engines and the prevention of explosion by dilution and other means.

As individual volumes, the books will prove useful to workers in the field of combustion research, both for reference and for mental stimulation. They are well produced and well documented. Most of the material reviewed has been published elsewhere, but there are references to many technical reports—American and British—that may well have escaped the attention of a number of readers.

J. H. BURGOYNE

THE SOLUBILITY PRODUCT PRINCIPLE. AN INTRODUCTION TO ITS USES AND LIMITATIONS. S. Lewin. Pp. xvii + 116. London: Sir Isaac Pitman & Sons, Ltd, 1960. 20s.

It is more than 60 years since Nernst formulated his solubility product principle, and since then it has been used extensively to discuss precipitation from solution and related phenomena. All too often the treatment in a textbook is such that the serious limitations in the use of both the concentration and activity solubility products are under-emphasized, or even ignored, so that many students possess an over-simplified picture of the applicability of the solubility product principle. This book discusses the limitations inherent in the usual derivation of the 'reduced solubility product' and the author proceeds to describe his own 'comprehensive solubility product.' He assumes an equilibrium involving hydrated ions, and rejects the assumption that the activity of the undissolved solid is unity or constant. He gives a useful survey of the range of application and the limitations of the 'reduced solubility product,' but is able, for lack of data, to do little more than discuss the application of his own principle qualitatively.

The book has nine chapters, dealing with the derivation of the solubility product principle; solubility product and solubility; solid solutions and basic salts; change of medium and dehydration effects; complex ion formation; the significance of the solubility product in relation to partial ionization; variation of equilibrium constants with temperature; lack of equilibrium conditions; and the significance of the solubility product in non-stable conditions. Selected topics are discussed further in nine appendixes, and there are a number of problems with answers, some having hints to aid their solution.

The book is quite well presented and should prove of value to both teachers and students. The reader will be left in no doubt that the problem of precipitation from solution is not a simple one. There are a number of minor printing errors in the text, most of them self-evident.

B. W. V. HAWES

RADIATION CHEMISTRY OF ORGANIC COMPOUNDS. (International Series of Monographs on Radiation Effects in Materials. Volume II.) A. J. Swallow. Pp. xiii + 380. Oxford: Pergamon Press Ltd, 1960. 84s.

Radiation chemistry had its beginnings in 1895, when high-energy radiation was discovered, but only recently has it become recognized as a separate branch of chemistry. It is distinct from radio-chemistry, which is the chemistry of radioactive elements, being concerned with the chemical effects of high-energy radiation on matter, and might be regarded as an extension of photo-chemistry. The subject has biological implications in a world made uneasy by the threat of nuclear warfare or accidental radioactive fall-out. It also has much industrial significance both as regards the construction

of nuclear power installations and the possible exploitation of ionizing radiations for food sterilization, grain disinfection and chemical synthesis, especially in the field of high polymers. Readers concerned with such subjects will find much of interest in this book.

Most radiation chemists will be familiar with the paper by Dr Collinson and Dr Swallow which appeared in 1956 in *Chem. Rev.* In some respects, the present book is an extension of this work. Except for the patent literature and atomic energy documents, coverage of the literature is complete from 1895 to mid-1958 and the extensive bibliography and indexes occupy nearly a quarter of the book. Remarkably, this enormous volume of information has been summarized adequately in a comparatively slim volume without turning it into a dry sterile review. Indeed, the book is a painstaking, wholesome account of the current status of radiation chemistry, written with a crisp style free from padding and tautology. Particularly useful features are the tabulations of quantitative data and the concise summaries at the end of each chapter, which correlate the theories presented and point to neglected areas requiring future work.

One of the remarkable features of radiation chemistry is that although the absorption of energy leading to bond fracture is random, changes of a highly specific nature often result. There is a definite tendency for the energy to concentrate at certain positions and for the weaker bonds to be broken. Much effort has gone into seeking an explanation for this phenomenon. Attempts have been made to correlate liquid-phase reactions produced by radiation with those occurring under high vacuum in the mass spectrometer, but the régimes are quite different and bimolecular reactions predominate in the former, whereas unimolecular decomposition is the more important process in the latter. Most radiation-induced reactions can be interpreted in terms of a free-radical mechanism, but more recently liquid-phase reactions involving an ionic mechanism have been discovered. To some extent this is due to the use of purified materials and more refined analytical techniques that give results more in harmony with theoretical expectations, allowing a more logical picture of radiation chemistry to emerge.

Though falling outside the title of the book, the radiation chemistry of water is briefly described, largely because the mechanisms are fairly well understood. In the chapter on aliphatic compounds, there are useful compilations of the  $H_2$  and  $CH_4$  yields from various hydrocarbons. It is interesting that at least 50 per cent of the hydrogen comes from processes not involving thermalized hydrogen atoms. The yield of crosslinks is shown to be independent of molecular weight by comparing low- $M$  hydrocarbons with polythene. This chapter also briefly reviews radiation polymerization.

The chief theme of the chapter on aromatic compounds is the comparative stability of these compounds due to

the excitation energy associating with the  $\pi$ -orbital electrons and becoming dissipated without appreciable chemical reaction. The radiation chemistry of polymers has been discussed comprehensively in recent books by Charlesby and Bovey, and the chapter on polymers adds little that is new. Such problems as the sensitization of polymers to radiation crosslinking and the effect of radiation on crystalline polymers, which have recently engaged attention, are not considered.

A chapter on dyestuffs emphasizes the role of radiation-induced coupled oxidation-reduction reactions, and the chapter on steroids, carbohydrates, amino acids, proteins, vitamins, enzymes and nucleic acids allows comparison of chemical changes *in vitro* with *in vivo* reactions and the behaviour of organized biochemical systems.

The book concludes enterprisingly with a discursive chapter, ranging from the history of the earth and the origin of petroleum to the economic and industrial aspects of radiation. The verdict is that the role of radiation in primary creation is plausible but not proven. The sensitivity of living organisms to radiation is discussed in terms of the target theory, which is also of value for the determination of the molecular weight of biologically active polymers. The author's assessment of the costs of radiation processing errs on the high side, and the industrial potential is estimated over-conservatively.

It is good lifemanship to draw attention to a few misprints or errors of fact, but this monograph has been meticulously checked at proof stage and not a single misprint was found. Only two passages were obscure and one may differ here and there from the views expressed, but I thoroughly enjoyed reading the book and believe that most fellow-scientists will do likewise.

S. H. PINNER

RADIOACTIVE TRACERS IN CHEMISTRY AND INDUSTRY. Pascaline Daudel. Translated by U. Eisner. Pp. xi + 210. London: Charles Griffin & Co. Ltd, 1960. 36s.

This work originally appeared in 1955 in French but is now published in English with additional material. As the scope is so wide, the treatment is necessarily rather superficial. In chapter 1 a selection of general principles is dealt with but some general knowledge of nuclear matters is presupposed. The main theme is the synthesis of tracer molecules, but a very short section on detectors, which barely mentions scintillation counting, and another on isotope effects are included. Some examples of the use of tracer techniques in the study of reaction mechanisms are given in chapter 2. The treatment is qualitative and does not include any reference to the use of isotope effects in the elucidation of mechanism. No book with this title could omit exchange reactions and analytical applications, and these are the subjects of chapters 3 and 4. The discussion on

exchange is adequate but chapter 4 is disappointing. The general theme is not developed in a very logical way, and the introduction of results obtained by  $\gamma$ -ray spectroscopy without any adequate explanation of this technique is confusing. So also is the appearance of a section on molecular structure by tracer studies (p. 132) in the middle of an analytical chapter. The final chapter describes the application of radio-tracer techniques in industry (pp. 27). The work ends with an appendix containing a description of four simple radio-chemical experiments, the inclusion of which I fail to understand.

It is difficult to know to whom to recommend this book. It is too elementary for the honours undergraduate and specialist, but on the other hand it presumes a general knowledge of nuclear science which I should have thought beyond the lay reader. The price seems very high.

G. B. COOK

RADIOISOTOPE LABORATORY TECHNIQUES. Second Edition. R. A. Faires and B. H. Parks. London: George Newnes Ltd, 1960. 25s.

This work is very similar to the first edition previously reviewed (J., 1958, 174-5) except that one chapter has been re-written to comply with changes in international recommendations on radiological protection. Unfortunately, most of the errors noted in the former review have remained uncorrected.

F. D. S. BUTEMENT

HANDBOOK OF MICROBIOLOGY. M. B. Jacobs and M. J. Gerstein. Pp. x + 322. Princeton: D. Van Nostrand Company Inc.; London: D. Van Nostrand Company Ltd, 1960. 64s.

The first half of this book gives the cellular, cultural, physiological and biochemical characteristics of about 160 micro-organisms, both bacteria and fungi. Needless to say, many important organisms are not included, for example, only two *Saccharomyces* are mentioned, no *Torula* and no *Neurospora*. It is difficult to see to whom such an incomplete list of organisms would be of use. When evaluating this information one naturally looks first at organisms about which one knows, and it is disconcerting to find under *Acetobacter suboxydans* the statements that it forms acid from sorbitol and from glycerol, neither of which is true, and that it can form tartaric acid from glucose, a statement which has been made but is not generally accepted. It states, on the other hand, under 'nutrition,' that it requires mineral salts, and either alcohol or glucose, or adequate substitutes; this seems hardly worth recording. Under *Aspergillus niger* we are told that the mycelium is submerged, which is usually untrue, and the list of growth factors omits nitrogen and magnesium. There is, further, a statement on the effect of arsenite which is

true only in strictly limited circumstances. Such unfortunate remarks on the first two organisms studied leave one with little respect for information on other organisms.

The rest of the book consists of about 40 tables dealing with classification, means of differentiation between organisms, culture media, indicators, buffers, staining techniques, shigella and salmonella serotypes, phenol coefficients and lists of bacterial and viral diseases—in all a very mixed bag of information. It also contains a chapter on antibiotics, with a short paragraph on each, but in only one case is a structural formula given. In no part of the book are there any references to original papers, and there are few indications of the sources of information. One cannot agree with the claim that this volume provides all the data needed for professional work in modern microbiology.

L. M. MIALI

LABORATORY AND WORKSHOP NOTES, 1956-58. (A fifth selection reprinted from the *Journal of Scientific Instruments*.) Edited by Ruth Lang for The Institute of Physics. Pp. xii + 218. London: Edward Arnold (Publishers) Ltd, 1960. 40s.

It has been the practice for some years now for selected papers from those published in the *Journal of Scientific Instruments* under the heading 'Laboratory and Workshop Notes' to be collected together in book form every two or three years. The present volume is taken from the 1956-8 issues of the *Journal*, and is the fifth selection compiled and edited by Dr Ruth Lang for the Institute of Physics. There are 119 items divided between six sections, and these represent about half the Notes which appeared in this period. Some editing has been found necessary and a number of introductory paragraphs and acknowledgements have been omitted, but this is far from a disadvantage, since it results in a compactness and a refreshing brevity which are found in few scientific papers.

In reviewing a book of this nature it is, of course, impossible to discuss individual papers owing to the wide variety of subject matter which is included even within the separate sections. The dividing lines between the sectional material are to some extent arbitrary, and, for example, some papers in the first section on mechanical design, workshop techniques and materials could equally well appear in the second section on laboratory techniques and devices. The other sections are, however, more easily defined. The three largest cover techniques and devices for use with liquids and gases, with vacua, and with electronic and electrical equipment, while the remaining section deals with optical and thermal methods.

The book is an invaluable one to have in a laboratory, and those who are already familiar with the *Journal of Scientific Instruments* will need no further recommendation. No indication has been given in the Preface of the way

in which this particular selection was chosen, but whatever principles were adopted I am pleased to say that I spent several fascinating hours browsing, and now know how to construct a vacuum leak and also how to operate a water-driven device for filling, aerating and agitating baths.

J. A. CATTERALL

THE A. T. GREEN BOOK. Edited by N. F. Astbury *et al.* Pp. x + 309. *Stoke-on-Trent: The British Ceramic Research Association*, 1959.

The A. T. Green Book is dedicated by his colleagues of the British Ceramic Research Association to Dr Arnold Trevor Green, C.B.E., Director of Research of this Association from the day of its foundation in 1948 until 1959.

By writing contributions to this book, his former colleagues have paid tribute to this man to whom not only the British Ceramic Research Association but also the British ceramic industry as a whole owes so much. The Association was founded by the amalgamation of the British Refractories Research Association and the British Pottery Research Association in 1948. The former was founded in 1929 and Dr Green was its Research Director from 1937 until 1948, when the fusion took place with the British Pottery Research Association. The latter was formed in 1937 by the British Pottery Manufacturers' Federation, all members of this Federation being members of the earlier Association. In the contribution written by T. Collinson and N. J. Bramhall on 'The Roots and the Growth of the B.C.R.A.' we are told that in the first year of its existence the membership of this Association was more than 500 firms and organizations, and that the yearly income exceeded £114,000. The staff of 130 included over 40 graduates and many trained technologists. The laboratory building at Penkhull, officially opened by H.R.H. The Duke of Edinburgh in December, 1951, cost £160,000, and the Clay Research Block a further £45,000. This project was financed out of the current income of the Association.

The B.C.R.A. deals with all technological and scientific aspects of the ceramic industry. This includes the heavy clay industry, which is engaged in the manufacture of structural products for the building industry, such as bricks, roofing tiles and pipes; the refractory industry, making heat-resisting structural products for the steel and gas industries and for the builders of industrial furnaces; and the pottery industry, which manufactures not only domestic ware but also insulators for the electrical industry and many articles for the chemical industry. The word 'ceramics' is of Greek origin (*Kerameus* and *Keramos* meant both the products of the potter and also the raw material, clay, used by the potter). Nowadays the term 'ceramics' is used in a wider sense, and includes all materials either made

plastic by clay or made plastic or workable by other means, provided that after shaping they are subjected to a firing process. Ceramics in the widest sense are therefore the products of high-temperature chemistry of non-metallic materials. Those special ceramics include, for instance, alumina articles such as sparking-plug insulators, titanium oxide and alkaline-earth titanates used as dielectrics for capacitors, ferrites (also called black ceramics) for magnetic materials, rare-oxide products for fuel rods and control rods in nuclear reactors, graphite for crucibles and many newly developed materials.

All problems connected with ceramics in the narrow and wider sense are being dealt with by the British Ceramic Research Association, and many of them are the subject of the 25 original papers published in the A. T. Green Book. These papers deal with both the more practical and the more theoretical aspects of ceramic science. The former include, for instance, the future of refractories in the gas industry (L. Sabiston), smoke abatement in the clay industries (E. Rowden), stoker firing of intermittent kilns in the heavy clay and refractories industries (C. N. Walley and A. E. Aldersley), new methods of studying kilns (W. H. Holmes), dust investigation in the ceramic industry (W. A. Bloor and J. M. Palmer), spit-out (W. T. Wilkinson and A. Dinsdale) and principles of electric furnace design (C. J. W. Baker). The more theoretical aspects are dealt with by such contributions as the constitution of bone china (D. G. Beech), glass structure and colour durability (C. E. L. Franklin and J. A. Tindall), an introduction to dynamic testing (N. F. Astbury and W. R. Davis) and many others.

These contributions show the wide range of interests of the B.C.R.A. and of their Research Director, Dr Green, and are of interest not only to the ceramist but also to the user of ceramic materials in the building, refractory, electrical and chemical industries.

The B.C.R.A. is unique. In other countries ceramic research is carried out by universities and publicly-owned institutions, mostly attached to universities, and by private firms. In this country, however, ceramic research is—apart from the laboratories of some of the larger firms—carried out by an association amply financed by all the members of the ceramic industry, equipped on a very lavish scale with all the necessary instruments, machines and furnaces, and employing a large staff of experienced ceramists and physicists. The research papers of the B.C.R.A. are available to members only, and as a consequence the British contribution to ceramic research is not very well known in other countries. The publication of the A. T. Green Book will, therefore, give ceramists in other countries some idea of the wide range of investigation carried out in this country.

ERNST ROSENTHAL

# Institute Affairs

EXAMINATION, JUNE 1961

## Graduate Membership, Part I

An Examination for Graduate Membership, Part I, will be held **on Monday and Tuesday, 19 and 20 June, 1961**, in London, and elsewhere at the discretion of the Council. Candidates will be asked to state their preference as to the centre for their examination, but it must be clearly understood that no guarantee can be given that their wishes will be met.

Candidates who have not yet been accepted and who wish to present themselves in June should obtain from the Assistant Registrar without delay the prescribed Application Form, so as to allow ample time for obtaining the necessary signatures certifying that they have complied with the Regulations concerning their courses of training. **The completed Application Form must reach the Institute not later than Monday, 17 April.** No application in respect of the June examination will be accepted after that date.

Entry forms will be sent as soon as they are ready to accepted candidates. **The last date for the return of Entry Forms will be Monday, 8 May, 1961.** No entry will be accepted if received after that date.

EXAMINATIONS, JANUARY, 1961

## Graduate Membership, Part I

*Examiners:* Professor C. C. Addison, Professor C. W. Davies, Professor W. J. Hickinbottom

The examination was held in London and at various local centres in the period 9-10 January, 1961.

The total number of candidates was 242, of whom 103 passed (42.56 per cent).

Of the 242 candidates, 11 had taken full-time courses, of whom four passed (36.4 per cent); 155 had taken part-time courses, of whom 53 passed (34.2 per cent); 53 had taken 'sandwich' courses, of whom 34 passed (64.15 per cent); 23 had taken part-time courses preceded by or followed by a period of full-time study, of whom 11 passed (47.8 per cent).

## Graduate Membership, Part II

*Examiners:* Professor W. G. Overend, Dr A. G. Sharpe, Professor W. F. K. Wynne-Jones

*Assistant Examiners:* Dr D. A. Frye, Dr A. D. Mitchell

The examination was held at the University of London, the theoretical papers being taken also at various local centres in the periods 9-14 January and 17-20 January, 1961. The total number of candidates was 89, of whom 24 passed (27 per cent).

Of the 89 candidates, one studied full-time and passed, three attended 'sandwich' courses (no passes), 26

attended part-time courses preceded or followed by a period of full-time or 'sandwich' study (nine passed; 34.6 per cent), 59 trained wholly by means of part-time courses (14 passed; 23.7 per cent).

Of the 24 candidates who passed Part II, 18 had either passed Part I or had been exempted from it under the current Regulations (75 per cent).

## PASS LIST : PART II

BARKER, Michael Raymond, College of Technology and Commerce, Leicester; City College and Art School, Norwich  
BUSH, Derek Raymond, S.E. Essex Technical College, Dagenham  
CHITTENDEN, Gordon James Frederick, Northern Polytechnic, London  
CROSBY, Thomas Spain, B.SC. (MANG.), College of Advanced Technology, Birmingham  
CROSS, John Thomas Daniel, Technical College, Kingston (Surrey)  
EARNSHAW, George Wyndham, Harris College, Preston; Wigan and District Mining and Technical College, Wigan  
FISHER, Keith, Harris College, Preston; Wigan and District Mining and Technical College, Wigan  
GLEN, Alan Ernest, College for Further Education, Stockport  
GOULD, Raymond Alfred, College of Technology, Hatfield  
GRAY, Stephen Percy, Technical College, Birkenhead  
HARRISON, Albert Keith, Royal Technical College, Salford; College for Further Education, Stockport  
HOLDING, Stanley Thomas, Central College of Further Education, Carlett Park, Eastham (Wirral); Denbighshire Technical College, Wrexham  
JOHANSEN, William Henry, Technical College, Birkenhead  
KERSHAW, Bernard John, College of Further Education, Widnes  
MOORE, Alan Thomas, College of Technology, Hatfield  
MORLAND, John Beadling, Rutherford College of Technology, Newcastle upon Tyne  
NIXON, Colin, Constantine Technical College, Middlesbrough  
RIDLEY, Daniel, Rutherford College of Technology, Newcastle upon Tyne  
SANDERSON, Harold Alec, B.SC. (LIV.), Royal Technical College, Salford  
SEWELL, Peter Aloysius, Technical College, Birkenhead  
STRIKE, Anthony Herbert, Medway College of Technology, Chatham  
SUDWORTH, James Lowe, College of Further Education, Widnes  
TURNER, Derick, Royal Technical College, Salford  
VOICE, Eric Handley, Northern Polytechnic, London; Nottingham and District Technical College, Nottingham; College of Technology, Oxford

## ANNUAL GENERAL MEETING

As already announced (*J.*, 55) the 83rd Annual General Meeting of the Institute will be held at 9.30 a.m. on Friday, 21 April, in the Assembly Hall, University of Southampton.

Corporate members in Great Britain and Ireland will receive, with this issue of the *Journal*, the formal notice of the meeting and other relevant papers. These include the Annual Report of the Council for 1959-60, copies of which are being sent at the same time to corporate members overseas and to all non-corporate members.

Ballot papers for the election of Censors and of Officers and General Members of the Council are being sent to corporate members in Great Britain and Ireland under separate cover at least one month before the date of the A.G.M.

## PROPOSED NEW GRADE OF MEMBERSHIP

At their meeting on 17 February the Council received the following report on the results of the Referendum on the proposal to establish a Licentiate grade of membership on the basis of the terms and conditions put forward in a Memorandum that had been issued to all corporate members:

Votes recorded FOR the proposal .. ..	5,617
Votes recorded AGAINST the proposal ..	1,376
Returns indefinite: qualified support ..	26
Total Voting Papers returned .. ..	7,019

Provision was made for corporate members overseas to record their votes by air letter, and a substantial proportion of them did so.

The total number of voting papers returned was much higher than in any previous postal ballot conducted by the Institute. The fact that nearly half the corporate members participated and almost exactly 80 per cent of these indicated support for the proposal is regarded as giving the Council a clear mandate to take the next steps towards introducing the proposed Licentiate grade.

The work of drafting the necessary changes in By-laws, with the advice of the Solicitors, has therefore been put in hand, so that formal resolutions for effecting these changes may be submitted to a Special General Meeting without undue delay. It is hoped that it may be possible to hold such a meeting in London in June. Due notice will of course be given in accordance with the provisions of the By-laws.

In the meantime the Study Group on Qualifications has already made some progress in considering the many matters of detail, especially on conditions of admission to Licentiate grade, that need to be settled before the relevant Regulations can be drawn up.

It will be appreciated that changes in By-laws approved by corporate members in General Meeting, with or without a subsequent postal vote, do not become operative until they have been submitted to and allowed by the Privy Council. Moreover, the introduction of a Licentiate grade will entail an extensive revision of the Regulations for Admission to Membership. It will be apparent therefore that, even if these various operations proceed according to plan, the new grade will take several months to establish. Progress will be reported from time to time, but it is too soon yet to predict when inquiries about admission to Licentiate grade can first be entertained.

## REGISTER OF FELLOWS AND ASSOCIATES

A new edition of the *Register of Fellows and Associates* of the Royal Institute of Chemistry, as at 31 October, 1960, with a supplementary list of Graduate Members, has reached an advanced stage of preparation and it is important that an assessment of the number of copies required shall be made in the near future.

The Council has decided that on this occasion the *Register* shall be supplied free of charge to any Fellow, Associate or Graduate Member who orders a copy on the **form enclosed** with this issue of the *Journal*. Completed forms should reach the Institute not later than Thursday, 30 March.

Every corporate member and Graduate Member whose registered address is outside the United Kingdom and the Republic of Ireland will receive a copy of the *Register* free of charge and without special request.

A Geographical Index will be issued shortly afterwards. This will be free to members ordering a copy of the *Register*; an order form for the Index will be enclosed with the copy when sent.

Copies of the *Register* will be available to non-members, firms and institutions, price 15s., post free.

**Film Index.**—The second edition of the *R.I.C. Index of Chemistry Films* is now available. This new edition contains up-to-date information on about 1,200 films and 300 filmstrips, classified by subject, followed by the addresses of the distributors and an alphabetical list of titles. The scope of this edition is much the same as that of the first, but there are nearly 50 per cent more entries due to the addition of new and newly-discovered items, and the date of production, where this can be ascertained, has been added to each film entry. The material has again been collected and arranged by Dr J. H. Pryor, Chairman of the Films Sub-Committee of the London Section. The publication of the *Index* is sponsored by the Institute's Fund for the Development of Education in Chemistry.

Copies of the *Index* may be obtained from 30 Russell Square, London, W.C.1 (price 5s.). Members who

obtained a copy of the first edition are strongly recommended to discard this and purchase the more comprehensive second edition. In this way not only will they have a more up-to-date reference book but distributors will be spared the inconvenience of dealing with requests for films that have been withdrawn since the first edition was published.

**Conferences on Teaching Inorganic Chemistry.**—A one-day symposium on the teaching of inorganic chemistry at pre-university level will be held in the Donnan Laboratories, University of Liverpool, on Saturday, 15 April. The symposium is being organized by the Liverpool and North-Western Section of the Institute. Further particulars and application forms may be obtained from 30 Russell Square, London, W.C.1, or from Mr H. R. Jones, Hon. Secretary, Liverpool and North-Western Section, The Central College of Further Education, Carlett Park, Eastham, Wirral.

A conference of lecturers on inorganic chemistry in National Certificate and Diploma Courses is being arranged by the Institute for Tuesday, 16 May, at the Birmingham College of Advanced Technology. The National Certificate Assessors in inorganic chemistry will be among the speakers; H.M. Inspectors and other representatives of the Joint Committee on National Certificates (England and Wales) will also be present.

**Institute Representatives.**—The Council has nominated the following *Fellows* to represent the Institute:

*Cambridgeshire Technical College: Science Advisory Committee:* Dr J. Williams (in succession to Miss M. Olliver);

*Belfast College of Technology: Board of Governors:* Professor C. L. Wilson.

**Health Congress, 1961.**—Dr F. D. M. Hocking has been appointed as the Institute's delegate to this Congress to be held in Blackpool on 24–28 April under the auspices of the Royal Society of Health.

**Binding of Journals and L.M. & R.**—Members and subscribers are reminded of the special arrangements for the binding of Journals in green buckram at the price of 19s. 6d. per annual volume, including return postage. Those making use of this service are asked to note that Volume 84 (1960) should contain the *Annual Report of the Council* for the year ended 30 September, 1960, which has been printed in the new format, and is being distributed with this issue.

Arrangements have also been made for the binding in grey cloth of *L.M. & R.* for 1959–60 in one volume, at 11s. 6d.

All inquiries and matter for binding should be addressed to W. Heffer & Sons Ltd, Hills Road, Cambridge.

## PERSONAL NOTES

### Honours and Awards

Mr E. B. Anderson, *Fellow*, has been awarded the Victoria Medal of Honour of the Royal Horticultural Society. The number of recipients of this medal is restricted to 63, the years of Queen Victoria's reign. Mr Anderson is an expert on alpine and hardy bulbous plants.

Dr Helena Bradbury, *Fellow*, senior lecturer in the department of chemistry and biology, Liverpool College of Technology, has been chosen to take part in the English-Speaking Union's plan for the exchange of technical teachers between Britain and the U.S.A.

Mr M. Kaufman, *Fellow*, a senior lecturer at the National College of Rubber Technology, has been awarded £450 by the trustees of the Plastics Industry Education Fund, to assist him in his research into the history of plastics.

### Societies and Institutions

Dr A. J. Amos, *Fellow*, has been nominated by the Council of the Society for Analytical Chemistry as President-Designate to take office at the Annual General Meeting this month.

Dr P. Cannon, *Associate*, has been elected Secretary-Treasurer of the Division of Colloid and Surface Chemistry of the American Chemical Society.

Dr Dorothy M. Farmer, *Fellow*, librarian to the British Plastics Federation, has been elected the first woman *Fellow* of the Plastics Institute.

### Educational

Mr P. R. Falkner, *Associate*, has been promoted to senior lecturer in analytical chemistry, Nottingham and District Technical College, with effect from 1 September.

Dr J. Lewis, *Associate*, has had the title of reader in chemistry in the University of London conferred upon him in respect of his post at University College.

Dr E. M. Mills, *Fellow*, formerly principal of Carlisle Technical College, has now taken over as principal of the new College of Technology at Chesterfield.

Dr J. W. Mullin, *Fellow*, has had the title of reader in chemical engineering in the University of London conferred on him in respect of his post at University College.

Dr T. P. Nevell, *Fellow*, has been appointed lecturer in textile chemistry at the Manchester College of Science and Technology, with effect from 1 January.

Dr S. K. Pavanaram, *Associate*, formerly of the Banting and Best Department of Medical Research, Banting Institute, Toronto, has now joined the department of pharmacy, University of Basel.

Dr M. A. Rahman, *Associate*, has been appointed Assistant Professor of Biochemistry, Basic Medical Science Institute, Karachi, Pakistan.

Dr F. Scheinmann, *Associate*, has recently returned from Israel, where he was a post-doctoral research fellow, Israel Institute of Technology, to take up a lectureship in organic chemistry at the Royal Technical College, Salford.

### Public and Industrial

Dr T. W. T. Baillie, *Associate*, has been appointed works manager, Carbide Industries Ltd, Northern Ireland.

Mr J. R. Bickerton, *Fellow*, has been appointed to the board of Fletcher Miller Ltd. He is chief chemist at the Alma Mills, Hyde, Cheshire, of the company.

Mr J. A. Bristow, *Associate*, has taken up a post as research chemist with the Swedish Packaging Research Institute, Stockholm. He was formerly with British Cellophane Ltd, Bridgwater.

Mr R. H. Del Mar, *Fellow*, has been appointed chairman of Lever Brothers (South Africa [Proprietary]) Ltd, with effect from 1 January.

Mr W. Fletcher, *Fellow*, has been appointed sales manager, stainless steel plant, A. Johnson & Co. (London) Ltd. He was formerly a senior chemical and project engineer with Constructors John Brown Ltd.

Dr J. A. Gascoigne, *Associate*, is now with Cross & Bevan Ltd, Arlesey, Bedfordshire. He was formerly a research chemist with the British Rayon Research Association, Manchester.

Mr A. G. Goodchild, *Associate*, has relinquished his position at Yarsley Research Laboratories Ltd to take up an appointment as a paper technical liaison officer, technical division, Wiggins Teape & Co. Ltd.

Mr B. N. Gopalkrishnan, *Associate*, formerly with United Breweries Ltd, Bangalore, has joined Phipson & Co. Private Ltd, Calcutta, India.

Mr C. Hull, *Fellow*, has been appointed general manager, Stanlow Refinery (Ellesmere Port), Shell Refining Co. Ltd.

Sir Patrick Linstead, *Fellow*, Rector, Imperial College of Science and Technology, has been appointed a member of the new committee of inquiry into higher education, under the chairmanship of Lord Robbins.

Dr M. V. Lock, *Associate*, has left the British Rayon Research Association, Manchester, to take up an appointment with the Deering Milliken Research Corporation, Spartanburg, South Carolina, U.S.A.

Mr D. Maciver, *Associate*, has recently been appointed a research chemist at the Pyrethrum Board of Kenya's laboratories in Nakuru, Kenya. He was formerly with British Resin Products Ltd.

Dr J. F. Marten, *Associate*, has recently been appointed chief chemist, Technicon Instruments Co. Ltd, London.

Dr S. R. W. Martin, *Fellow*, a director of W. A. Mitchell & Smith Ltd since 1953, has been appointed managing director.

Dr R. M. Mathur, *Associate*, has been appointed assistant production engineer, Dhrangadhra Chemical Works Ltd. He was formerly chemical engineer.

Dr E. Mehl, *Fellow*, formerly research superintendent, Deloro Smelting & Refining Co., Ontario, is now with Sheritt Gordon Mines Ltd, Fort Saskatchewan, Alberta, Canada.

Miss M. H. Neal, *Associate*, has been appointed manager, Kingsway Chemists Ltd, United Africa Company of Ghana Ltd, Takoradi, Ghana.

Mr G. Nunn, *Associate*, has been appointed deputy manager, Burgh of Motherwell Sewage Department. He was formerly assistant chemist, Leicester Corporation Sewage Department.

Dr S. Rangaiyengar, *Associate*, has been promoted to assistant chief chemist, Bhilai Steel Works, M.P., India.

Dr W. D. Scott, *Fellow*, managing director of B.T.R. Industries Ltd, has been appointed chairman of three of its subsidiaries: Artrite Resins Ltd; Glass Yarns and Deeside Fabrics Ltd; and Microcell Ltd.

Mr M. A. Short, *Associate*, has joined the technical staff of Bell Telephone Laboratories, Murray Hill, New Jersey, having completed the requirements for the Ph.D. degree in fuel technology of the Pennsylvania State University. He will receive this degree in June.

Mr A. Steele, *Fellow*, Rector, Graeme High School, Falkirk, has been appointed a member of the working party set up by the Secretary of State for Scotland to consider means of improving links between secondary schools and further education.

Dr E. H. Wiseman, *Associate*, formerly a postdoctorate research fellow at the Ohio State University, Columbus, is now a research chemist, Chas. Pfizer & Co. Inc., Groton, Connecticut, U.S.A.

**Permutit Co. Ltd.**—Dr E. I. Akeroyd, *Fellow*, has been appointed deputy managing director and Dr T. V. Arden, *Fellow*, a director.

### Retirements

Dr R. Child, *Fellow*, director of the Tea Research Institute of East Africa, is to retire on 31 March.

Mr A. Glover, O.B.E., *Fellow*, retired as head of the C.W.S. Technical Research Department in July, 1960.

Mr C. R. Middleton, *Fellow*, general manager, Stanlow Refinery, Shell Refining Co. Ltd, has retired.

Mr D. G. Murdoch, *Associate*, production manager at the Beckton Products Works of the North Thames Gas Board, retired in January after over 40 years' service with the Board and the former Gas, Light & Coke Co.

Mr H. C. J. Saint, *Associate*, technical officer (inorganic micro-analyst) Imperial Chemical Industries Ltd, Metals Division, has retired.

Dr G. H. Smith, *Fellow*, general manager of Scottish Oils Ltd, has retired after almost 40 years' service with the company.

# Section Activities

## ABERDEEN AND NORTH OF SCOTLAND

*Production of Fertilizers.* 'The Production of Phosphoric Acid and Ammonium Phosphate-based Fertilizers' was the title of a lecture given to a joint meeting by Dr J. S. S. Reay on 19 January. Dr Reay considered the place of compound fertilizers in the pattern of farming today and discussed their manufacture, dealing in particular with the making of phosphoric acid by the wet process and its subsequent conversion to ammonium phosphate. The reaction system for this was described, as well as the ancillary equipment for proportioning and mixing in other ingredients to give a compound fertilizer. The importance of accurate analysis was stressed. Finally, Dr Reay dealt with the granulation and drying of fertilizer and the relation of this and subsequent storage to its physical condition.

After discussion, the meeting closed with a vote of thanks proposed by Dr W. Moore.

## BRISTOL AND DISTRICT

*Colour Photography.* Some 700 schoolchildren heard the Christmas lecture given by Dr H. Baines on 3 January.

As recently as 1801, the only type of radiant energy recognized by man was light, but in that year both infra-red and ultra-violet radiations were discovered. Since then, an extremely wide band of electromagnetic radiations has been discovered, with wavelengths varying from a millionth of a millionth of a centimetre to 500 miles. They include cosmic rays,  $\gamma$ -rays, X-rays, ultra-violet light, infra-red heat rays and radio waves. The reason man's built-in receptor, the eye, confines itself to an insignificantly narrow band in this enormous range were discussed.

Colour perception was considered, and typical colour-matching experiments were described, leading to the trichromatic theory of colour vision, that is, to the idea that the eye has three overlapping colour receptors, one sensitive mainly to red, one to green and one to blue, and that all colours in nature are seen because of the differential excitation of these three receptors.

Clerk Maxwell argued that if this theory were correct one should be able to produce a colour photograph by recording and subsequently combining the red, green and blue constituents only of any and every colour. He tried the experiment and obtained the first colour photograph exactly 100 years ago—he showed the result at the Royal Institution in 1861. His method, which was described by the lecturer, formed the basis of the *additive* method of colour photography. It is remarkable that Clerk Maxwell's experiment had the sole object of supporting the trichromatic theory of vision, and he attached little significance to his achievement in producing the first colour photographs. Indeed, his method

was rather impracticable, but a series of ingenious improvements brought the additive method to its peak in the years between the wars. The lecturer described and illustrated separate screen, random screen and geometric screen methods.

The additive process, however, contains certain defects which are inherent and therefore incurable. These are not present in a complementary process—the *subtractive* process. The difference between the additive and subtractive processes was described. Briefly, while the additive process separately records and adds together the amounts of red, green and blue *reflected* from every portion of the original, the subtractive process records the amounts of these three colours *absorbed* by all portions of the view from the illuminating light, and successively subtracts these amounts from white light. Red-, green-, and blue-absorbing dyes will transmit the complementary colours, and the lecturer demonstrated how the superposition of green-blue, magenta and yellow positive transparencies built up a colour photograph.

A discussion of methods of obtaining the three records simultaneously and of converting them into appropriate colour records led to a description of the integral tripack and colour development, both of which are now common to all commercial processes. Processing by reversal gives positive colour transparencies; negative colour development gives a colour negative reversed in colour as well as black and white.

The subtractive process has completely ousted the additive process, but it contains certain defects in colour-rendering inherent in any trichromatic method of colour photography. The errors are negligible for the desaturated, wide-band colours usually occurring in nature, and even with saturated colours they are normally unrecognized. However, when a colour transparency is duplicated these defects have thus been introduced twice, and duplicates are generally less acceptable. The colour prints obtained from transparencies by enlargement and reversal colour processing are duplicates of the original transparency, and it is for this reason that prints are sometimes disappointing compared with the original transparency. If colour prints are required, then a negative-positive process, of which several are on the market, may give more satisfactory results.

The colour of any object depends on the colour of the illuminating light, and there is a great difference in colour between lights normally considered as white, for example between daylight and tungsten light. This difference is not apparent to the eye because of the eye's capacity of adaptation. Tungsten light is much richer in red and poorer in blue than daylight, but in tungsten light the eye's red receptor becomes overworked and insensitive while the blue receptor becomes much more sensitive. This results in a white area appearing white under a wide range of illuminating colours. This local

fatiguing of receptors was convincingly illustrated to the audience. Photographic emulsion sensitivity naturally shows no such effect, so that, to produce a white as a white and other colours appropriately balanced, materials of differently balanced sensitivities have to be used for daylight and tungsten light.

The lecturer finally warned that, although modern colour photographic materials will give most acceptable colour reproduction, they cannot be used as scientific implements for the accurate measurement or reproduction of colour.

#### CARDIFF AND DISTRICT

*Production of Radioisotopes.* The Section held a joint meeting with the South Wales Section of the Society of Chemical Industry on 20 January at the Newport College of Technology, Allt-yr-yn. Dr J. C. Charlton, of the Radiochemical Centre, Amersham, lectured on 'Problems in the Production of Radioisotopes.'

Dr Charlton opened his lecture by comparing local industries, whose products are measured in thousands of tons, with the radioisotopes industry, where yields are often measured in micrograms.

Problems associated with the  $(n, \gamma)$  reaction, in which the radioactive product is the same chemical element as the target material, were first discussed. When certain target materials are irradiated in the pile only one isotope is formed, for example cobalt on irradiation gives only  $^{60}\text{Co}$ . Antimony on irradiation gives a mixture of  $^{122}\text{Sb}$  and  $^{124}\text{Sb}$ ; the latter can be obtained in a pure form by storing the product for about six weeks, when the short-lived  $^{122}\text{Sb}$  (half-life  $2\frac{1}{2}$  days) has decayed to 0.2 per cent of the  $^{124}\text{Sb}$  (half-life 60 days). Similarly, iron on irradiation gives a mixture of  $^{55}\text{Fe}$  and  $^{59}\text{Fe}$ . Here, unfortunately, it is the shorter lived  $^{59}\text{Fe}$  which is in greater demand, and the only practicable way to produce it is by using the stable isotope  $^{58}\text{Fe}$  that has been separated from the other stable isotopes of iron in a form of giant mass-spectrometer.

In a wide variety of applications, a high specific activity—that is, a large amount of activity associated with a given weight of material—is essential, and one of the major problems in the last 10 years has been the achievement of high specific activities. The use of enriched stable isotopes often gives a substantial increase of specific activity, and in the past the Szilard–Chalmers reaction, in which advantage is taken of the fact that the radioactive material produced on irradiation is in a different chemical form from that of the target material, was often used.

High-flux piles, such as DIDO, are now available, and their use in conjunction with enriched stable isotope targets is particularly helpful. Space is valuable and the small size of such isotope targets saves space; on the other hand, enriched stable isotopes are expensive, and the high fluxes mean that only small quantities of these materials are needed. High-flux reactors are

not without their disadvantages. They are expensive to run, access and space are limited and the dissipation of heat developed in the target proved a major problem. Some difficulties arise from a rather peculiar cause, namely, consecutive  $(n, \gamma)$  reactions. When gold is irradiated at low flux the product is practically pure  $^{198}\text{Au}$ . The  $^{198}\text{Au}$  will undergo a second  $(n, \gamma)$  reaction, giving  $^{199}\text{Au}$ , and the rate of production of this is proportional to the square of the flux. In BEPO the amount of  $^{199}\text{Au}$  is about one per cent of the  $^{198}\text{Au}$ ; in DIDO  $^{198}\text{Au}$  and  $^{199}\text{Au}$  are present in equal amounts at the end of a typical irradiation.

The other important reaction for pile isotope production is the  $(n, p)$  reaction in which the radioisotope formed is a different chemical element from the target. Energetic neutrons are usually necessary to cause this type of reaction to take place, and it is necessary to carry out reactions near to, or even inside, the fuel elements. The  $(n, p)$  reaction raises fascinating chemical problems; microgram quantities of the radioisotope elements have to be separated from gram or even kilogram quantities of target. Dr Charlton described a number of the methods in use, including ion-exchange and solvent-extraction techniques. What was once a major annoyance only to analytical chemists—the absorption of traces of impurities on precipitates—has become an essential technique of the work. The Radiochemical Centre has made possible important contributions in the development of 'dry-extraction' processes for the major radioisotopes. One example is the preparation of  $^{32}\text{P}$  by the irradiation of elementary sulphur. It has been found possible to distil the sulphur, leaving all the  $^{32}\text{P}$  behind in a form that readily gives orthophosphate.

The lecturer concluded with a discussion of the plant and equipment for handling radioisotopes safely.

After Dr Charlton had answered a number of questions the Chairman, Mr H. K. B. Rout, called on Mr K. F. Williams to propose the vote of thanks.

#### DUNDEE AND DISTRICT

*Chemical Education.* There was a record attendance at a Symposium on Chemical Education held at Dundee Technical College on 20 January.

Dr T. J. Morrison, head of the department of chemistry at the College, said that the science taught in Scottish schools is based on out-of-date theories. Children at school are taught various theories and ideas which have to be discarded eventually at universities and technical colleges. Other theories which could be taught at an early stage are left until later, when they are more difficult to assimilate. Dr Morrison also made a plea for a 'modest publication' in which teachers and others interested in science could air their views and discuss theories.

Dr K. M. Watson, of Queen's College, said she was distressed at the difficulties encountered by students

going from school to university. A common failing is the inability of many students to work by themselves, and of those who have the ability to get a degree many fail because they cannot become adjusted quickly to the different way of life.

Of the science students who go to Queen's College, about 50 per cent come from England, and in the first session they are a year ahead of their Scottish counterparts. The introduction of the new Scottish Certificate of Education, planned for 1962, should help to overcome this discrepancy.

Reference to this new Certificate was also made by Mr W. S. Gray, H.M. Inspector, Scottish Education Department, who pointed out that the revised examination system would bring this qualification within the reach of a far greater number of students.

Mr D. Brown, of the Morgan Academy, said that under the present examination system he is expected to turn out as many students as possible with university entrance qualifications but who really know nothing apart from material learnt parrot-wise, and of little use to them. He wanted a more general examination paper set.

Mr N. Champion, an honours student at Queen's College, made a plea for less learning of facts at university and more scope for exploration in a general field.

Professor J. W. L. Adams, Professor of Education at Queen's College, presided. A vote of thanks was given by Professor A. D. Walsh.

#### EAST ANGLIA

*Preservation of Antiquities.* A joint meeting with the Norfolk Research Committee was held on 20 January in Norwich, when Dr A. E. Werner, keeper of the laboratory of the British Museum, gave a lecture on 'Chemistry in the Preservation of Antiquities.' Mr H. F. Bamford was in the Chair. Several aspects of preservation were described, involving widely different materials, and the lecture was illustrated by a selection of lantern slides. A lively discussion ended the meeting, and the vote of thanks was proposed by Dr Calvin Wells of the Norfolk Research Committee.

*The Chemist as a Colleague.* At a meeting in Ipswich on 14 February a lecture entitled 'The Chemist as a Colleague' was given by Dr W. Preston, a consulting chemical engineer. He discussed the contribution that can be made by the chemist to the engineer's work in the design and construction of chemical plant. The lecture was followed by an interesting discussion. Mr Bamford was in the Chair and the vote of thanks was expressed by Dr E. C. Wood.

#### EAST MIDLANDS

*Rocket Fuels.* The last meeting of the Section for 1960 was held at Derby on 13 December, when Dr W. G. S. Parker spoke on 'Rocket Fuels.' The meeting was well

attended, reflecting the general interest in modern propellants in this space age. A report of the lecture has already appeared (*J.*, 29). Mr Oldham took the Chair, and the vote of thanks was proposed by Mr M. S. J. Twisleton.

*Forensic Science.* Mr D. N. Jones gave an illustrated talk on 'Forensic Science' at Nottingham on 19 January. After a brief review of the origin and distribution of forensic science laboratories in this country, Mr Jones went on to describe the range of activities of these laboratories. He showed a large number of interesting slides—some rather gruesome, some in a lighter vein—all well illustrating the many ways in which scientific methods nowadays assist in the detection of crime and the conviction of criminals. After a short discussion, the vote of thanks was proposed by Dr R. F. Phillips.

#### EDINBURGH AND EAST OF SCOTLAND

*Chemistry and Brewing.* On 12 January, at a joint meeting with the local sections of the Chemical Society and the Society of Chemical Industry held in the Heriot-Watt College, Mr G. W. Walker took the Chair and Dr A. H. Cook, F.R.S., Director of the Brewing Industry Research Foundation, delivered a lecture entitled 'Chemistry and Brewing—a New Outlook.'

Dr Cook pointed out how, with modern techniques, the empirical approach used in previous years in the brewing industry is being replaced by one of a more fundamental nature. Recent advances in analytical techniques have made significant contributions to the control of quality and the development of continuous-brewing processes. The specific gravity of wort can be determined with extreme sensitivity by measurement of its transparency to  $\beta$ -radiation, and automatic methods for analysing the sugar content and determining the bittering materials have been developed. Investigations into the frothing of beers showed that the defect of 'gushing' is caused by the nucleating effect of small particles, which are also responsible for haziness. Chemical analysis showed these particles to be a mixture of proteins and tannins originating from the barley. Haze can be removed and the shelf life of the beer greatly improved by filtration with nylon powder. The chemistry and origin of the tannin components, leuco-anthocyanins, have been studied in detail and the new knowledge is leading to the development of modified mashing processes. Many advances have been made in the chemistry of the hop resins, the isohumulones and hulupones, responsible for bitterness, but there is still a considerable amount of work to be done on the isolation and characterization of more compounds to fully elucidate this field. Dr Cook concluded with a practical illustration of the use which had been made of these fundamental studies in the development of pilot-scale continuous-brewing processes. Mashing is conducted in a circular segmented rotating

tun, and hopping is carried out on a multiple 'coffee-percolator' technique in which boiling wort is recirculated over the hops on a moving belt. Two new fermentation processes have been studied, one on a continuous principle and one on an accumulating batch principle in which the wort is added to the yeast. The advances in fermentation were possible only because of the basic studies of the yeast cell itself and its action. This is a good illustration of how fundamental knowledge has been put to practical ends, which could never have been achieved by the previous empirical methods.

After a vigorous discussion, Professor I. A. Preece proposed the vote of thanks.

*Annual Dinner.* The Annual Dinner of the local sections of the Society of Chemical Industry, the Chemical Society and the Institute was held in the Roxburgh Hotel, Edinburgh, on 20 January. Dr G. O. Aspinall, of the Chemical Society, took the Chair. Professor M. Swann, F.R.S., the principal guest, proposed the toast to the three Societies. In his speech, he referred to the importance of the cross-fertilization of ideas between the various disciplines of science, especially in the study of the living cell. Dr Aspinall replied, and thanked Professor Swann on behalf of the three Societies. Dr E. A. C. Chamberlain proposed the vote of thanks to the Chairman.

*Hydrocarbon Complexes of Transition Metals.* On 31 January, at a joint meeting with the Chemical Society, the Society of Chemical Industry and the University of Edinburgh Chemical Society held in the University, Professor P. L. Pauson, well known as the discoverer of ferrocene, gave a lecture on the organometallic complexes of the transition metals. Starting with a discussion of the structure of ferrocene, the first 'sandwich' compound, Professor Pauson went on to outline the new field of chemistry which has emerged in the last decade, including complexes of transition-metal carbonyls containing various organic groupings. In particular he discussed the chemistry of alkyl manganese penta-carbonyls in relation to the catalytic action of manganese carbonyls in the oxo process. The lecture was extremely well attended, particularly by younger members, and Professor Pauson was accorded a warm vote of thanks for an extremely interesting lecture.

#### GLASGOW AND WEST OF SCOTLAND

*Film Night.* On 13 January a joint meeting with the Glasgow Section of the Society of Chemical Industry was held in the Royal College of Science and Technology, Glasgow. Dr J. Sword opened the meeting, at which five colour films were shown.

'The Continuous Do-Maker Process' (Wallace & Tiernan Ltd) showed the effect of automation in the bread-making industry. Finer products with less waste of material lead to higher sales and lower running costs.

'An Introduction to Ion Exchange' (Permutit Co. Ltd), showing models of typical resins and animated diagrams, demonstrated clearly the mechanism of ion exchange. The uses of various resins were shown in a remarkable series of convincing demonstrations.

'Quick Freeze' (Unilever Ltd) illustrated, with the aid of animated and often amusing diagrams, how the abundant produce of nature can be preserved with its texture and flavour unimpaired.

In the film 'Darwin and the Insects of Brazil' (Petroleum Film Bureau) Dr H. B. D. Kettlewell followed in the footsteps of Darwin overseas. Selected examples of insects, butterflies and moths were used to illustrate the special defence mechanisms necessary for survival in the Brazilian forest.

Finally, 'Borgo a Mozzano' (Petroleum Films Bureau) recorded an experiment to raise the living standards of the agricultural community of Borgo a Mozzano, a community of 16 hamlets in Tuscany, Western Italy.

Professor P. D. Ritchie, Vice-Chairman of the Section, closed the meeting with a word of thanks to the organizers of the show.

#### HUDDERSFIELD

*Ladies' Night.* The annual 'Ladies' Night' of the Section was held on 12 January at the White Swan Hotel, Huddersfield. Mr G. Osgood, of John C. Carlson Ltd and British Frames Ltd, briefly described the German wine-making industry, and spoke of the contributions of chemists to modern practices. A series of colour slides were then shown illustrating all stages of the growing of vines and some typical vineyard country and villages. Six wines, demonstrating the effect of Riesling, Ruländer and Traminer grapes and the summers of 1958 and 1959 on the quality of the vintage, were tasted.

#### HULL AND DISTRICT

*Rubber in Chemical Plant.* On 2 February a joint meeting was held with the Hull Chemical and Engineering Society at the University of Hull. Dr T. S. Harrison presided, and a lecture was given on 'Rubber in Chemical Plant' by Messrs E. Allcock and J. L. F. Crompton, both of the Dunlop Rubber Co. Ltd.

The number of polymeric materials which can be used for lining plant has increased considerably in recent years. Natural rubber is used in conjunction with fillers and sulphur to form a whole range of rubbers and ebonites. Natural rubber compounded with 25-30 per cent sulphur gives relatively hard ebonite. Semi-flexible ebonites can be made by dilution of the normal ebonite with butyl rubber or neoprene, giving butyl or neoprene ebonites. In general, softer linings have greater abrasion resistance at the expense of chemical resistance, and *vice versa*.

Recently much work has been done on the lining of equipment with polypropylene and polythene. Owing

to the big difference in the coefficients of expansion of these two polymers compared with metal, a satisfactory direct bond cannot be achieved. The problem has been overcome by laminating the polypropylene to natural rubber and bonding the rubber to the surface of the vessel, when the differences in expansion are accommodated by the rubber.

Rubber protective paints were discussed, in particular those based on neoprene and Hypalon.

The choice of material and the form in which it is applied depend very much upon the specific application, and in some instances it is simpler and more practical to install ready-made rubber linings in the vessels. Such linings are used in some cases in reservoirs that have developed serious leakage.

The methods of curing linings in large vessels were described. These ranged from boiling water for several hours in the vessel and blowing in live steam to vulcanizing in steam-heated autoclaves. Particular care has to be taken to ensure perfect lining, and an electrical method of testing for faults was described.

The lecture was illustrated by slides, and during and after the meeting numerous samples were available for inspection. After a lively discussion, the vote of thanks was given by Mr F. H. Plaster.

#### LONDON

*Summer Visits.* Members of the Section were asked to reply to a questionnaire covering a number of possible arrangements for these visits, and to add any additional comments they might wish to make. Of the 199 replies received, 172 suggested changes.

Hitherto most visits have been on mid-week afternoons but there was a substantial demand for a greater range of times. Thus 63 members asked for visits in the evening, 65 on a Saturday morning, 65 Saturday afternoon, 79 all Saturday, 66 on a weekday during August and 107 on a weekday during April.

Opinion on the type of visit was evenly divided, those in favour of visits of general interest numbering 73, whilst 81 were in favour of visits of a definitely chemical character; 45 members had no preferences.

A number of individual comments of an extremely varied and useful character were also made, and the Committee is grateful for the help of those who completed the forms.

The results of this questionnaire were studied by the Development Sub-Committee, which regarded them as an indication that a large proportion of those who took part in Summer Visits were content with the programme provided. Some of the requests were well worthy of consideration and, as far as possible, will be implemented in the 1961 programme. The season is being extended to run from April until the end of July.

*Aromatic Fluorine Compounds.* Professor M. Stacey lectured on the work of the University of Birmingham

School in organic fluorine chemistry on 8 December at the Northampton College of Advanced Technology.

He first explained the historical events which introduced a completely new type of work to a large natural products research group during World War II, and then discussed the technique of fluorine production on a laboratory scale. Possible fluorination techniques and the preparation and use of cobaltic fluoride were outlined.

Fluorination of paraffins was mentioned, and the discovery of the very complex products arising out of the fluorination of benzene described from the personal experience of the lecturer in his capacity as director of the work of the Birmingham department.

The development of vapour-phase chromatography as a comparatively large-scale separation technique in this work (100-g scale or more) proved of special interest to the audience.

The intricate problems of configuration and isomerism were shown in a series of slides, and as a final topic Professor Stacey discussed the preparation of pentafluorobenzene and its derivatives, pointing out that it was here possible to study the orienting effect of one hydrogen atom in a benzene ring containing five fluorine atoms. Some of the unexpected general reactions of pentafluorobenzene derivatives were also examined.

Throughout the lecture, the great industrial effort being put into fluorine chemistry in the U.S.A. was stressed, and the lecturer emphasized the vital necessity for more industrial investment in this field in Britain.

The meeting was closed by the vote of thanks proposed by Dr J. Leicester.

Many specimens of pure organic fluorine compounds and of fluorine-containing polymers were on show after the lecture.

*Science and Archaeological Investigation.* The annual joint meeting of the Kent Sub-Section with the Gravesend Engineering Society was held at the Gravesend Technical College on 10 January. On this occasion members of the Gravesend Historical Society were also present. The Chairman, Dr T. Dewing, introduced the speaker, Mr H. M. W. Hodges.

Mr Hodges opened the lecture by pointing out that the questions usually asked by the archaeologist about any object were: 'how old is it?' 'is it genuine?' 'how was it made and of what?' 'how can it be preserved?' The scientist's work, therefore, usually came under some of these headings, which are frequently interrelated.

Age can be relative or absolute. Relative age can often be established by archaeological methods, for example position in undisturbed strata. In the case of fossil bones, the fluorine content can be used if comparison with authentic samples from the same environment can be made. The Piltdown Skull was mentioned as an example of a specimen which was shown not to be

ancient by this technique; the authenticity of the Swanscombe Skull (of local interest) had been confirmed by the same method.

Absolute age of specimens of organic material can be measured by the  $^{14}\text{C}$  method, which gives good results, e.g. 2000 B.C.  $\pm 150$  ( $P = 0.66$ ), and has necessitated some corrections to dates deduced by other and less direct means. Its main disadvantage is the need to destroy substantial amounts of the specimen to obtain the carbon as carbon dioxide or methane for making the measurements.

The first approach to discovering whether a specimen is genuine is often by chemical analysis; for example in the case of fraudulent Chinese 'bronzes' that may be made from brass castings, chemical analysis shows clearly which specimens are genuine. Some copies are made from genuine examples by electrotyping, and in this case the joint may be found. Usually the density is different from that of genuine bronzes. The false patina which has to be stuck on can be detected by means of the adhesive used and its composition. Examination of this kind may entail some damage to the specimen, and wherever possible non-destructive measures, such as X-ray diffraction spectrometry, are used.

In answering the question 'how made and of what?' the chemist can often give evidence of age or place of origin. In the case of bronze objects, for example, the earliest examples are of nearly pure copper, followed by tin-copper bronze, and still later by leaded bronzes which are easier to work. In the case of cobalt blue glazes the Chinese glaze contained several trace elements absent from similar European blue glazes.

Similarly, in the case of Roman pottery, much of which can be identified by the potters' marks, it has been shown that each pottery had its own characteristic composition. The presence of tanning materials in samples of leather can be shown by paper chromatography of an extract, and in some cases the kind of tanning process used can be characterized.

The preservation of specimens usually involves two stages, cleaning and conservation. The first frequently involves the removal of deposits of calcium carbonate or sulphate by careful treatment with appropriate acids. The cleaning of iron and steel objects has to be done with great care, as they are often largely converted to corrosion products, and these alone may show the shape of the original object. The complete removal of ferric chloride from iron by repeated extraction with distilled water to prevent further rusting is the first essential operation, and the rusted fragments may need support.

Decayed and waterlogged wood is particularly difficult to preserve, as it very rapidly shrinks and distorts when removed to a normally-dry atmosphere, thus obscuring both its character and botanical identity. In this case it has been found convenient to replace the contained water with a polyethylene glycol of  $M$  about 4000.

It is often necessary to secure the co-operation of specialists in other fields, the work of fibre microscopists and dye analysts in the examination of coloured fabrics being an example.

Mr Hodges concluded by commenting on the small numbers of scientists fully engaged in this work, there being only about 12 in this country with four engaged on  $^{14}\text{C}$  dating.

A discussion followed the lecture, and the vote of thanks was proposed by Mr Harrap, Vice-President of the Gravesend Engineering Society.

*Aspects of the Chemistry of Living Cells.* On 18 January, at King's College, Professor Sir Cyril Hinshelwood, O.M., F.R.S., lectured on 'Aspects of the Chemistry of Living Cells.' Mr A. J. Turnbull presided.

The lecturer said that studies on enzyme chemistry or nucleic-acid structure gave valuable information on cell chemistry, but the chemistry of living cells could only be understood by examining the co-ordination of the processes within them. Experimentally, this involved measuring cell size and number, enzyme activities and concentration of cell constituents at intervals in the course of bacterial growth in simple media. From such experiments, evidence was derived for a view of the cell in which it is supposed that the formation of any constituent is governed by the amount of at least one other constituent, and that cell division occurs to maintain a more or less constant amount of a particular constituent. The average deoxyribonucleic acid (DNA) content of a cell is in fact almost constant through the growth cycle. Ribonucleic acid appears to be present partly as a reserve for DNA synthesis and may also determine the growth rate.

If the cell operates in this way, a steady state, which is optimal for the conditions, is reached, and the cell should also adapt itself to changes in the medium. Thus an *Aerobacter* culture transferred from glucose to arabinose as the carbon source exhibits a long lag. The cell mass then increases rapidly and soon afterwards the cells multiply. The adaptation to arabinose is readily lost unless serial subcultures have been made, when it appears to become more nearly permanent. An alternative way in which a culture in new conditions may be established is that the initial inoculum contains a few organisms which are already capable of growth, and the culture is established from these. Here there would be no variation in the mean cell weight. Examples of this mechanism are found in the development of resistance to some, but not all, antibiotics.

After a lively discussion, in which the names of Darwin, Lamarck, Lysenko and Newton were heard, Dr Salmon proposed the vote of thanks to Professor Hinshelwood.

*Chemical Control of Plant Diseases.* On 23 January, the Section was privileged to have a further lecture from

Professor R. L. Wain, F.R.S., who addressed an audience at Enfield Technical College. Mr A. J. Turnbull was in the Chair.

The lecturer began by discussing plant disease control in relation to world food production, which is becoming ever more important as world population steadily rises. He pointed out that pathogenic fungi are responsible for considerable crop losses in spite of the big advances which have been made, for example, in breeding for disease resistance and in chemical control measures.

Professor Wain stressed the importance of having a full knowledge of the properties of the chemicals used, as well as an understanding of the biology of the host and its parasites, in order to use chemical control to best advantage. He pointed out that no chemical can be put to its fullest use until its mode of action has been elucidated, though such basic problems are invariably complex and demand a many-sided attack with close collaboration between the different scientists concerned.

The speaker gave a review of present-day fungicides, including the older inorganic materials such as copper and sulphur preparations and an ever-widening range of organic substances. Some basic problems underlying the use of fungicides on plants were discussed, and a brief account was given of the fungicidal action of copper and sulphur.

Much of the lecture, however, was concerned with developments in the newer field of systemic fungicides, particular attention being given to work which is proceeding in Professor Wain's laboratory at Wye.

The lecture was aptly illustrated with lantern slides, including some excellent ones in colour. Following a discussion, the vote of thanks was proposed by Mr R. Sheppard.

*The Toxicology of Fluorine Compounds.* On 24 January, Dr B. C. Saunders lectured at the Technological Research Station, Spillers Ltd, Cambridge, on 'The Toxicology of Fluorine Compounds.'

He began by outlining the development of organic fluorine compounds of possible military use, which was initiated in Cambridge during 1939. He discussed the role of the organo-phosphorus compounds used as nerve gases, explaining the insidious action of these compounds on the nervous system in detail.

The toxicological approach to the testing of such new and probably toxic agents is in three stages; first the compounds are tested on animals, then on human subjects and finally on enzyme systems.

In discussing the mode of action of these compounds, the lecturer indicated that if any other halogen was substituted for the fluorine the compound did not show such intense toxicity. The molecule is bound to the enzyme by virtue of hydrogen bonding between fluorine and a suitable point on the enzyme, such as an oxygen atom. This allows the phosphorus atom to

approach the site of action. Hence other compounds that similarly form hydrogen bonds can show this activity. The phosphorus may be removed from the enzyme by nucleophilic attack, and such antidotes are available, but as they are themselves toxic they are of limited use.

The work on fluoroacetates carried out at Cambridge during the same period was reviewed, and again the physiological action was outlined. In this case, there is interference with the Krebs tricarboxylic acid cycle, leading to an accumulation of citric acid in the system, with concomitant formation of fluorocitric acid.

Dr Saunders showed that the carbon-fluorine bond in these compounds is extremely stable, being unaffected by concentrated sodium hydroxide solutions. This at once raises the problem of decontamination, and indeed the breakdown of these compounds would appear to be difficult by conventional methods. However, the lecturer mentioned some experiments in which covalently-bound fluorine had been converted into the ionic state by treatment with hydrogen peroxide and peroxidase.

Dr Saunders mentioned that often compounds originally prepared for their toxicological action had since found other uses. The widespread use of the organophosphorus insecticides is perhaps the most significant; the lecturer gave many instances of the medical use of these compounds.

The extended question time showed the interest with which this lecture had been received, and such topics as the chronic effects of organophosphorus poisoning and possible antidotes, the type of chemical warfare at present conceivable and the possibility of homicide by these means were ably discussed by Dr Saunders.

Dr J. Williams took the Chair, and the vote of thanks was proposed by Mr J. Harris.

*Magnetism in Inorganic Chemistry.* On the occasion of the joint meeting with the College Scientific Society at the Slough College of Further Education, the Section was welcomed by the Principal. In thanking him, the Section Chairman, Mr P. A. Raine, drew attention to a number of comments which had recently been made about the large size of the Section. He pointed out that while these comments were receiving serious consideration, one method of meeting the difficulties of a large section area was the formation of sub-sections, such as those of Kent and Cambridge. He then introduced Professor R. S. Nyholm, who gave a lecture on 'Magnetism in Inorganic Chemistry.'

Professor Nyholm described briefly the origins of the magnetic properties of molecules and the differences between the various types of magnetism. He dealt with the use of paramagnetism in the elucidation of the problems of inorganic chemistry, and described in some detail the various types of behaviour shown by paramagnetic substances, with particular reference to the

effect of temperature on magnetic moment. A description of apparatus for measuring paramagnetic susceptibility at one temperature or over a range of temperatures was given.

The lecturer then used a number of examples to illustrate the value of susceptibility measurements in providing information, in suitable circumstances, about the oxidation state of a metal, its co-ordination number and the stereochemistry of complex compounds. In particular, attention was drawn to the effect of metal-to-metal bonds of either  $\sigma$  or  $\pi$  type on the magnetic properties of ions such as  $[\text{Ni}_2(\text{CN})_6]^{4-}$  or  $[\text{W}_2\text{Cl}_9]^{3-}$  and in molecules such as those of cupric acetate. In such cases exceptionally low paramagnetic moments or the occurrence of diamagnetism alone provided a clue as to the probable structure.

Professor Nyholm then referred to several examples of complexes in which the central atom showed an unusual co-ordination number that could be deduced from the magnetic properties, including  $[\text{Mo}(\text{CO})_3\text{I}_2\text{-Diarsine}]$   $[\text{Re}(\text{diarsine})_2\text{Cl}_4]\text{Cl}$  and similar eight co-ordinate complexes of technetium.

The lecture was followed by a short but lively discussion. The vote of thanks was proposed by a member of the College Scientific Society, and the meeting closed with an expression of thanks to the Principal from the Chairman for the facilities provided for the meeting.

*Social Evening.* On 12 January a film show was held at the Technological Research Station, Cambridge, by kind permission of Spillers Ltd. Dr J. Williams, Chairman of the Sub-Section, welcomed members of the Institute and their guests.

The films shown were 'Point of New Departure'; 'Fine Chemicals for Medical Use'; 'Glass Makers'; and 'Beauty in Trust.' A long interval during which light refreshments were served provided an opportunity for informal discussion.

*Research and Development in D.S.I.R. Stations.* A joint meeting with Brighton Technical College Chemical Society was held at the College on 3 February. Dr Watts, the Principal of the College, welcomed the visitors and invited Dr J. E. Salmon to take the Chair. Dr Salmon introduced the speaker, Sir Harry Melville, K.C.B., F.R.S.; Secretary to the Department of Scientific and Industrial Research, and called upon him to deliver his lecture on 'Research and Development in D.S.I.R. Stations.'

After a brief explanation of the nature of the D.S.I.R., Sir Harry gave an interesting account (summarized in *J.*, 1960, 32) of the application of chemistry to a variety of problems which had engaged the attention of the Department in recent years.

Mr J. A. Hunt proposed a vote of thanks and Dr Salmon closed the meeting with an expression of thanks to the College authorities.

#### MID-SOUTHERN COUNTIES

*Work of the Railway Chemist.* On 16 January a meeting was held jointly with the Portsmouth and District Chemical Society at the Portsmouth College of Technology. Mr E. Henley, of the Research Department, British Railways, gave a lecture entitled 'The Work of the Railway Chemist.'

Mr E. Henley explained that British Railways can be regarded as a factory, 1,900 miles long. To serve this immense undertaking and keep the machinery moving all the time, nine chemical laboratories, situated from Glasgow to Ashford, are required.

The first records of chemists serving the railways go back to 1859; such chemists have through the years been connected with a wide variety of materials, from air to zinc. Their work consists mainly of analysis, especially of purchases made by British Railways (£150 million per annum), and advisory work, from the packaging of articles to the cleaning of rolling stock.

Topics discussed included fuel analysis, control of drinking supplies, effluents from railway workshops, spectrographic analysis of trace elements in diesel lubricating oils, timber preservation, the fire resistance of protective coatings and deciphering the date of issue of a defaced season ticket for the British Transport Commission police.

Mr Henley concluded with an interesting account of the increased use of plastics both in rolling stock and buildings. The lecture was illustrated by slides; after questions, the vote of thanks was proposed by Mr D. H. Bell.

#### NEWCASTLE UPON TYNE AND NORTH-EAST COAST

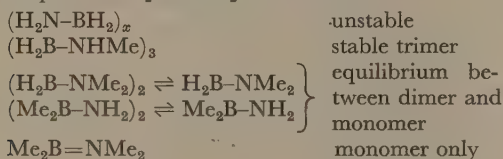
*Annual Dinner and Dance.* Over 90 members and their guests attended the Annual Dinner and Dance arranged jointly with the Society of Chemical Industry and the Chemical Society. The event, held in the County Hotel, Newcastle, was equally successful with those of previous years, and all present had a most enjoyable evening.

*Organometallic Compounds.* On 25 January a well-attended meeting was held jointly with the Society of Chemical Industry at the Rutherford College of Technology, Newcastle, when Professor G. E. Coates, of the University of Durham, spoke on 'The Co-ordination Chemistry of some Organometallic Compounds.'

Professor Coates began by considering the nature of the boron-nitrogen link in the compound  $\text{Me}_3\text{N-BMe}_3$ , and showed that the force constant and other physical data were consistent with the views of Sidgwick and Pauling in that many of the properties of the co-ordinate link  $\text{A}^+-\text{B}^-$  were almost identical with the covalent link  $\text{A-B}$ . However, a large number of compounds are now known in which the donor and acceptor atoms are co-ordinatively unsaturated, implying the formation of either a double bond between them if the compound

is monomeric or association to form polymeric units in order to achieve co-ordinative saturation. Normally, association occurs; for instance,  $(\text{Me}_2\text{N}-\text{AlMe}_2)_2$  forms a dimer containing a 4-membered ring whilst  $(\text{MeBe}-\text{NMe}_2)_3$  forms a trimer containing a six-membered ring.

The simplest amino-borane,  $\text{H}_2\text{N}-\text{BH}_2$ , is known only in a polymeric and unstable form, but as the hydrogen atoms in it are replaced by methyl groups the 'normal' tendency to associate becomes less, as shown below, until the compound  $\text{Me}_2\text{N}-\text{BMe}_2$  is monomeric.



The force constant of the boron-nitrogen bond in  $\text{Me}_2\text{B}-\text{NMe}_2$  is  $7.5 \times 10^{-5}$  dyne  $\text{cm}^{-1}$ , a value very close to that of the  $\text{C}=\text{C}$  link in ethylene, showing that a co-ordinate double bond is formed between boron and nitrogen. The low dipole moment of  $1.4D$  indicates that this double bond must be strongly polarized. A similar link has been shown to be present in the borazine,  $\text{B}_3\text{N}_3\text{H}_6$ , ring.

In the case of aryl boranes the situation can be complicated by a steric effect shown by the fact that the compound  $(\text{phenyl}_2\text{B}-\text{NH}_2)_2$  forms a dimer, whereas  $\text{mesityl}_2\text{B}-\text{NH}_2$  and  $\text{phenyl}_2\text{B}-\text{NMe}_2$  are both monomeric owing to steric interference between *o*-methyl and *N*-hydrogen and orthohydrogen and *N*-methyl groups, respectively.

The lecturer then described recent work on phosphino- and arsino-diarylboranes, which are monomeric, in contrast to the cyclic or polymeric phosphino boranes ( $\text{R}_2\text{P}-\text{BR}'_2$ ,  $\text{R}' = \text{alkyl or H}$ ) studied by A. B. Burg and others. Infra-red and more particularly dipole moment studies on the phosphinodiarylboranes exclude the possibility of phosphorus acting as a  $\pi$ -donor to boron in these compounds. It is concluded that the  $\pi$ -donor character of phosphorus and arsenic towards boron is very weak in comparison with the  $\sigma$ -donor character.

#### STIRLINGSHIRE AND DISTRICT

**Radioactive Elements.**—The annual Christmas lecture to schoolchildren, sponsored by the Section, was given on 20 December by Mr E. Jenkins, formerly of the U.K.A.E.A., assisted by Mr A. Wood. More than 500 schoolchildren from Clackmannanshire, Stirlingshire and West Lothian attended the lecture, which was given both in the morning and afternoon. The speaker was introduced by Mr Goldie, the Director of Education for Stirlingshire, and dealt with some of the properties of  $\alpha$ -,  $\beta$ - and  $\gamma$ -radiation, the properties of neutrons and some of the uses of nuclear reactors.

Natural  $\alpha$ -activity was demonstrated by holding 10 g of uranium metal close to an  $\alpha$ -particle detector; the audience heard a 'bleep' as each uranium atom dis-

integrated. A more powerful source consisting of about one millionth of a gram of plutonium was then substituted and used to demonstrate the properties of  $\alpha$ -particles. They were easily stopped by a sheet of paper, thin surgical gloves or a half-inch Perspex sheet. Air stops  $\alpha$ -particles also, and their range of a few centimetres was demonstrated. By means of a cloud chamber, the audience was able to see the tracks caused by condensation of water vapour on ions produced when  $\alpha$ -particles collide with air molecules. The equipment necessary for handling  $\alpha$ -emitters was also on view.



Mr Jenkins then demonstrated the detection of  $\beta$ -particles by a Geiger tube, the source being  $^{90}\text{Sr}$ . Unlike  $\alpha$ -radiation,  $\beta$ -rays have a fairly long range in air and are not so easily stopped; a sheet of paper had no effect, while rubber gloves reduced the radiation only to one-half. We can detect  $\beta$ -particles by the cloud chamber but this is rather difficult; the ionization caused by  $\beta$ -radiation was shown by the discharge of a gold-leaf electroscope and by the release of a charged balloon adhering to a vertical surface. This property is useful in the field of static eliminators, particularly in the textile industry. These particles are fast-moving electrons and should therefore behave as an electric current; the deflection of a beam of  $\beta$ -particles by means of a magnet was demonstrated.

More penetrating even than  $\beta$ -particles,  $\gamma$ -radiation will pass through Perspex, floorboards, bricks and so on. A member of the audience was invited to use a Geiger tube to locate a hidden  $\gamma$ -source ( $^{60}\text{Co}$ ).

Mr Jenkins stated that very few elements spontaneously emit neutrons. To produce these most readily, plutonium is sintered with beryllium powder. Such a neutron source was used to demonstrate the formation of an artificial radioactive isotope by bombarding a silver sixpence with neutrons and measuring the half-life of the radioactive  $^{109}\text{Ag}$  so produced.

Mr Jenkins concluded with a brief review of some of the uses of nuclear reactors, including the production of many artificial radioelements, particularly  $^{60}\text{Co}$ , which

may be used as a cheap replacement for radium, and the determination of trace elements—even of arsenic in suspected cases of criminal poisoning—by radioactivity analysis.

A vote of thanks was proposed by Mr Goldie.

*Joint Meeting.* At a joint meeting of the Section and the S.C.I. held in Stirling on 25 January, Mr L. H. C. Hawkins, Chairman of the local section of the S.C.I., introduced two lectures by Mr H. G. Sykes and Mr G. F. Murdoch on 'Recent Developments in the Technology and Chemistry of Breadmaking' and 'Wood Preservation,' respectively.

In a very interesting lecture on the chemistry of breadmaking, Mr Sykes, of the Distillers Co. Ltd, Menstrie, briefly traced the historical development of breadmaking processes. The older and more haphazard methods of fermentation by barm or brewer's yeast have now been replaced by fermentation with carefully selected cultures under controlled conditions. The storage of doughs in various stages of fermentation is wasteful of both time and space. Recent work has shown that dough development can be greatly accelerated by intense mechanical mixing and by the addition of oxidizing agents such as potassium bromate or iodate to the dough. These facts have been used to develop a continuous process.

A great deal of work has been done in order to pinpoint the constituents of bread responsible for the flavour, but this has proved difficult owing to the great complexity of acids, aldehydes, ketones, alcohols and esters which can result from the complicated biochemical cycles. In addition, flavouring components form in the crust and are drawn into the centre of the loaf on cooling.

A very recent process involves instantaneous cooking by high-frequency heating, followed by infra-red heating. The entire process lasts 50 minutes and enables the output of bread to be stepped up enormously. Unfortunately, as with bread from other continuous processes, the flavour is different from that produced by the old-fashioned methods of yeast fermentation followed by slow baking, and flavour improvement remains one of the big problems facing the industry today.

In his lecture on 'Wood Preservation' Mr Murdoch outlined the various factors which cause the destruction of wood. The organic binding constituents of the wood are attacked by fungi that require an aqueous medium for metabolism. Two types of fungi are prevalent; one—the dry rot fungus—takes its water supply with it as it penetrates the timber, whilst the other acquires the necessary water from the wood itself, which usually contains 20–25 per cent water. Other destroyers of wood—wood-boring beetles such as the furniture beetle and the death-watch beetle—were briefly mentioned.

Mr Murdoch continued by explaining the action of wood preservatives that could either poison the insect as it seeks nutrition, or combine chemically with the constituents of the wood, thus reducing the food available for the insect and resulting in its death from starvation. The preservatives, which can be classed under the three headings, tar oils, aqueous solutions and organic solutions, should possess certain properties, such as non-toxicity, lack of odour, ability to accept paint and so on, depending on the use to which the preserved wood is to be put. Creosote, a well-known preservative, comes under the heading of tar oil. It is made to a British Standard of sufficiently wide tolerances to include blends of different fractions from tar distillation. Creosote is used extensively for exterior woodwork. The second category, which is exemplified by copper chromate solutions, the chromate being reduced by the chemical constituents and resulting in the deposition of a basic salt, is used for interior woodwork. Derivatives of naphthalene and other polynuclear compounds are examples of the third type of preservative.

After a lively discussion, Dr F. Fowkes, Vice-Chairman of the Section, expressed the appreciation of the meeting to the two speakers, and all agreed that the presentation of papers by members of the local sections was an important aspect of the Section's activities.

#### TEES-SIDE

*Scientific Journalism.* On 19 January Professor Ritchie Calder, C.B.E., gave a lecture on 'Scientific Journalism.' He described how scientific journalism started in the early 1930s in the U.K. Scientists were hostile to journalists, and the gap had to be bridged. He went on to mention his first task in this sphere, that of writing an article on the atomic nucleus in collaboration with Lord Rutherford. A. Haslett and J. D. Crowther were then the only other science journalists in the U.K.

One of the difficulties in explaining science to the public is to avoid the trip-words used by scientists—words, each having its own meaning, which grow with science. Difficulties in style and presentation which have not been overcome in scientific journalism are those in mathematics and chemistry. Mathematics is a language in its own right; explanations of chemical structures such as benzene offer their own problems.

Since the 1930s advances have been made, and the public are now science-conscious. The Association of British Science Writers, formed in 1946, is now helping to maintain the standards of scientific journalism.

After a discussion, the meeting (the best attended for some time) was closed by Dr I. J. Faulkner, who thanked Professor Calder for a stimulating lecture.

#### MADRAS

*Annual General Meeting.* The A.G.M. of the Section was held on 4 February at the Madras Medical College,

when Professor K. S. S. Varadan welcomed members and guests. After the report for the year 1959-60 had been read, the following members were elected Officers and Members of Committee for the year: Chairman, Dr S. V. Anantakrishnan; Hon. Secretary, Mr N. Pitchandi; Members of Committee, Professors A. R. Natarajan and K. S. S. Varadan and Messrs K. Narayanasamy, M. S. Rama Iyer, K. R. Srinivasan, K. V. Sundaram Ayyar and R. Viraraghavan.

Mr K. R. Srinivasan, the retiring Chairman, addressed the gathering on the working of the department of the Government Analyst in Madras. He said that there was a popular misconception as to the exact nature of the work done in his department. Quite often he received samples intended for the forensic science laboratory or the chemical testing and analytical laboratory. He gave a brief account of the nature of the work done by a Public Analyst.

Dr A. H. Beckett, Head of the School of Pharmacy, Chelsea College of Science and Technology, the chief guest of the evening, then addressed the meeting. He dealt with some of the aspects of paper chromatography and demonstrated how the  $R_F$  values are affected by the different experimental conditions. He also spoke of the work done on the stereo-selective adsorbents. Lastly, he discussed the new technique of separation using dextran polymers, which allow the large molecules to come through even in the first run, the smaller ones being retained.

After a film show, members and guests attended the Annual Dinner.

#### MALAYA

*Annual Dinner.* The Annual Dinner was held at the Cathay Restaurant, Singapore, on 3 February. Dr Toh Chin Chye, Deputy Prime Minister, addressed the gathering.

In the field of scientific development in Singapore the task is twofold, firstly, to encourage students to study scientific and technical subjects in school, the university, the polytechnic and other institutions and thereby to increase the output of trained scientists and technologists; and secondly, to provide a broad base for the development of science by educating the people in fundamental, simple scientific truths and applications.

This broadly is the government's programme for scientific education, and it looks to the Institute to come forward and play its part in the advancement, organization and propagation of science.

In the execution of the first task the government has already made a beginning by placing a bias on scientific and technical education. More science laboratories will be built in secondary schools, and a commission to inquire into the rationalization of technical education in Singapore is now sitting. More bursaries and scholarships are now given to students reading scientific or technical subjects, and professional allowances are given

to scientific and technical personnel in the service of the government.

To carry out the second task the government intends to set up a science and industry museum. The purpose of this museum will be to present to laymen the principles of scientific laws and their application.

The Institute should take a leading part in the propagation and popularization of science. As the oldest scientific organization in the country, it should rightly be in the forefront in bringing science out of the laboratory so that the people will understand through lectures, demonstrations, exhibitions and conversations not only the workings of science but also how scientific applications play a vital part in national development. In this way the scientists and technologists will contribute to the awakening of a national consciousness.

Professor A. K. Kiang, Chairman of the Section, welcomed members and guests, and said that the Section was especially honoured by the presence of the Deputy Prime Minister and the Minister of Education and Mrs Yong Nyuk Lin.

The Section was founded in 1924, the first of the overseas Sections, and today has a membership of 62. Members are serving Malaya in various fields, for instance, in the University of Malaya, schools, various research centres and industries, and have played an important part in the public service of Malaya and in its industrial and economic development.

In recent years there have been positive signs of industrial expansion in Malaya, such as the building up of Petaling Jaya, the Redhill and Jurong satellite towns, new factories and the proposed oil refineries and steel mills. All these augur well for the economic future of Singapore and the Federation of Malaya. The Section supports the official educational policy and efforts to encourage and intensify the study of science and the training of scientific personnel. To attain maximum efficiency and productivity more and more research must be carried out, and steps are being taken to set up scientific and industrial research institutes.

The Section has instituted a Memorial Medal in Chemistry, which is awarded annually to the most outstanding student of chemistry at the University of Malaya in Singapore. Another will be instituted for Kuala Lumpur. It is hoped that another medal might be awarded annually to the most promising young scientist in the field of applied science and technology.

*Annual General Meeting.* At the A.G.M. held in the department of chemistry, University of Malaya, Singapore, on 4 February, the following were elected Officers and Members of Committee: Chairman, Mr B. C. Sekhar; Hon. Secretary and Treasurer, Mr K. H. Lee; Liaison, Singapore, Dr K. H. Loke; Members of Committee, Drs K. P. Ang, W. Rintoul and G. A. Watson and Mr T. T. Tan.

# News and Notes

## MEETINGS AND CONFERENCES

**Achema, 1961.**—The European Convention of Chemical Engineering, includingACHEMA, 1961, 13th Chemical Engineering Exhibition-Congress, will take place at Frankfurt am Main on 9–17 June. The Annual Meeting 1961 of the DECHEMA Deutsche Gesellschaft für chemisches Apparatewesen e.V. will be held on 10–14 June. The Gesellschaft Deutscher Chemiker is organizing a special meeting and lectures on 14 June to mark the association of chemists with the ACHEMA Congresses since 1920. A symposium on 'The Physical and Chemical Durability of Structural Materials in Chemical Engineering' will take place on 15 June, and the Annual Meeting 1961 of the Isotopen-Studiengesellschaft e.V. on 16 June. Registration forms and further information may be obtained from the Congress Business Office, Dechema-Haus, Frankfurt am Main, Rheingau-Allee 25, Germany.

**Chemical Institute of Canada.**—The 44th Canadian Chemical Conference and Exhibition of the Institute will be held on 3–5 August at the Queen Elizabeth Hotel, Montreal. The Chairman of the exhibits committee is D. S. MacKay, Du Pont of Canada Ltd, P.O. Box 660, Montreal, from whom further details of the exhibits can be obtained.

**Conférence Internationale des Arts Chimiques.**—The 6th Salon International de la chimie and the Conférence Internationale des Arts Chimiques, which had been announced provisionally for June, 1962, will now be held from 25 April to 4 May, 1962, at the Centre National des Industries et des Techniques (C.N.I.T.), Rond-Point de la Défense, Puteaux, Paris. Programmes may be obtained from the General Secretariat, 28 rue Saint-Dominique, Paris 7<sup>e</sup>.

**Conference on Palaeomagnetism.**—The Institute of Physics and the Physical Society are arranging a conference on Palaeomagnetism to be held at King's College, University of Durham, Newcastle upon Tyne, on 20–22 April. Further information may be obtained from the Administrative Assistant, Physics Department, King's College, Newcastle upon Tyne, 1.

**Congress of Industrial Chemistry.**—The 33<sup>e</sup> Congrès International de Chimie Industrielle will take place on 28 September–8 October, at Toulouse (28 September–1 October) and Bordeaux (1–8 October). Those wishing to submit papers should send a *résumé* (50 lines) by 1 June to the Comité scientifique du Congrès, Faculté des Sciences, 20 Cours Pasteur, Bordeaux, Gironde, France. Full particulars of the Congress may be obtained from the Commission

permanente d'organisation des Congrès, 28 rue Saint-Dominique, Paris 7<sup>e</sup>.

**Congress of Pure and Applied Chemistry.**—The 18th International Congress of Pure and Applied Chemistry will take place in Montreal on 6–12 August, in connection with the 21st Conference of the International Union of Pure and Applied Chemistry (2–5 August). The Congress will include five plenary lectures, to be given by Professors F. S. Dainton (Leeds), R. Daudel (Paris), G. Schwarzenbach (Zurich) and R. H. Wilhelm (Princeton) and Academician N. N. Semenov (Moscow); there will also be about 60 invited sectional lectures and many other contributed papers. Further information may be obtained from the Secretariat, 18th International Congress of Pure and Applied Chemistry, National Research Council, Ottawa, Canada.

**Faraday Society.**—A general discussion on Radiation Effects in Inorganic Solids will take place at the Centre d'Études Nucléaires de Saclay, Gif-sur-Yvette, S. et O., France, on 11–12 April. Further details may be obtained from the Assistant Secretary, Faraday Society, 6 Gray's Inn Square, London, W.C.1.

**Insecticide and Fungicide Conference.**—The British Insecticide and Fungicide Conference will be held at Brighton on 7–10 November, under the auspices of the Association of British Manufacturers of Agricultural Chemicals. Scientific workers carrying out research in appropriate subjects are invited to make contributions at the Conference. Details of these subjects, together with registration forms, may be obtained from Mr W. A. Williams, Secretary, ABMAC, Cecil Chambers, 86 Strand, London, W.C.2.

**International Congress of Cosmetic Science.**—The Second Congress of the International Federation of Societies of Cosmetic Chemists, organized by the Society of Cosmetic Chemists of Great Britain, will take place in London on 2–5 July, 1962. The themes of the Congress will be (a) Biological Aspects and (b) Physical Chemistry. Anyone wishing to submit a paper describing original work is requested to contact the Hon. Organizer, Mr A. Herzka, c/o Pressurized Packaging Consultants Ltd, Ashbourne House, Alberon Gardens, London, N.W.11.

**IUPAC Symposium.**—An International Symposium on Macromolecular Chemistry will be held in Montreal on 27 July–1 August, sponsored by IUPAC and the Division of Polymer Chemistry of the American Chemical Society. The Canadian High Polymer Forum will be the host. The provisional programme includes high polymers in solution; properties of solid polymers; polymerization; reactions of high polymers; and natural colloids. Further details may be obtained

from the Organizing Committee, P.O.Box 816, Sarnia, Ontario, Canada.

**Metallic Corrosion.**—The First International Congress on Metallic Corrosion will take place in London on 10–15 April, as already announced (*J.*, 1960, 374). Membership is open to all interested persons and the fee of £5 is payable to the First International Congress on Metallic Corrosion, 14 Belgrave Square, London, S.W.1.

**School in Agricultural Science, 1962.**—The 9th Easter School in Agricultural Science of the University of Nottingham School of Agriculture will be held on 2–6 April, 1962. It will take the form of a symposium and colloquium under the general title of 'Antibiotics in Agriculture.' The advance notice, which should be available about December, may be obtained from Dr Malcolm Woodbine, Microbiological Unit, Department of Agricultural Sciences, University of Nottingham School of Agriculture, Sutton Bonington, Loughborough.

**Society of Chemical Industry.**—The Fine Chemicals Group of the S.C.I. is holding a conversazione on 24 March at 6.30–10 p.m. An exhibition on 'Perfumes and Cosmetics—their Preparation and Use' will be presented jointly by International Flavors and Fragrances (Great Britain) Ltd and Stafford Allen & Sons Ltd; during the evening a demonstration of the correct use of cosmetics will be given, by courtesy of Yardley & Co. Ltd. Inquiries should be addressed to the Assistant Secretary, S.C.I., 14, Belgrave Square, London, S.W.1.

**Textile Institute Annual Conference.**—The 46th Annual Conference of the Textile Institute will be held in Harrogate on 15–19 May. Its subject is 'Bulked Yarns and other Modified Textiles.' The Conference fees are 5 guineas for members and 10 guineas for non-members. Further particulars may be obtained from the General Secretary, Textile Institute, 10 Blackfriars Street, Manchester 3.

## EDUCATIONAL

**Courses for Teachers.**—The Ministry of Education is arranging for a group of heads of departments of chemistry from technical colleges to visit the Ruhr on 7–14 May to study German methods of training chemists and chemical assistants. The course, which has been planned with the co-operation of the Kultusministerium of North Rhine-Westphalia will be under the direction of Mr J. Maitland-Edwards, H.M.I., Staff Inspector for Chemistry. Further particulars about the course may be obtained from the Ministry of Education (Teachers Short Courses: No. N.59), Curzon Street, London, W.1.

**Dip. Tech. Courses.**—The National Council for Technological Awards has announced that there are now nearly 5,000 students enrolled on courses leading to the award of the Diploma in Technology. Altogether there are 101 courses in operation, of which two full-time and 12 sandwich courses are in applied chemistry, chemical technology or industrial chemistry.

The total number of students in the chemistry courses is 512, of whom 219 are in the first year, 150 in the second, 94 in the third and 49 in the fourth year. Of the 219 first-year students, 180 qualified for entry by the General Certificate of Education, 36 qualified by Ordinary National Certificate and three were admitted with other qualifications.

**I.R.I.-P.I. Joint Examination.**—Early in 1957 the Institute of the Rubber Industry and the Plastics Institute set up a Joint *ad hoc* Education Committee to examine ways and means of increasing educational collaboration, and a Joint Examinations Board has been set up. Courses based on new agreed syllabuses for the Associateship examination of the I.R.I. and the Graduateship examination of the Plastics Institute will come into force as from September, and the first final examination under the Joint Examinations Board will be completed in 1964.

**Ramsay Memorial Fellowship.**—The Trustees will consider in June applications for a Ramsay Memorial Fellowship for advanced students of chemistry. The value of the Fellowship will be £700 per annum, to which may be added a grant for expenses of research not exceeding £100 per annum. The Fellowship will normally be tenable for two years.

Full particulars can be obtained from the Joint Honorary Secretaries, Ramsay Memorial Fellowships Trust, University College London, Gower Street, London, W.C.1. Completed application forms must be received not later than 17 April.

**S.M.A. Annual Meeting.**—The Annual Meeting of the Science Masters' Association was held in the University of Glasgow from 3 to 6 January. The programme included lectures and demonstrations, visits, discussions, films and the usual exhibitions by members, manufacturers and publishers. In addition there was a special exhibition on atomic and molecular structure and nuclear energy, arranged by the Central Electricity Generating Board, the United Kingdom Atomic Energy Authority and various manufacturing firms.

Lectures of particular interest to chemists were given by Professor R. A. Raphael on 'Big Rings,' Dr Magnus Pyke, F.R.S.E., on 'The Boundaries of Science,' Dr J. C. Speakman on 'The Study of Molecules by X-ray Crystal Structure Analysis' and Dr J. N. Davidson on 'The Chemical Basis of Heredity.'

The programme included visits to various university departments as well as to industrial concerns such as

B.P. Petroleum Refinery, British Hydrocarbon Chemicals Ltd and Imperial Chemical Industries Ltd, Dyestuffs Division, all at Grangemouth and Fibre Glass Ltd, Glasgow, in addition to the traditional visits to breweries.

The President of the S.M.A. for the ensuing year is Sir Patrick Linstead, *Fellow*.

**Association of Women Science Teachers.**—The Annual Conference of the Association was held in the Lecture Theatre of the Science Museum, South Kensington, on 27–28 January.

On 27 January, Dr J. A. Harrison, chief executive officer, Educational Foundation for Visual Aids, showed three films, 'The Cross Spider,' 'The Principles of X-Rays' and 'The Photoconductive Effect,' and afterwards discussed new science films that will soon be available.

On 28 January, the Annual General Meeting was held, and reports were given by representatives on the Science Teachers' Joint Sub-Committee, the Examinations Sub-Committee and other associations and committees. At the conclusion of the business meeting Miss L. Buckley, of the Grey Coat Hospital School, Westminster, was elected President of the Association for the next two years, and Miss H. B. Fell, F.R.S., an Honorary Life Member. An informal talk, with demonstrations, a film and discussion, was then given by Mr R. M. Longstaff, T.D., Scientific Administration Branch, A.E.R.E., Harwell.

In the afternoon, Miss Going, the retiring President, gave her Presidential Address, which was followed by a general discussion on 'The Place of Science in the School Curriculum,' with special reference to the publications *Science in Secondary Schools* (Ministry of Education Pamphlet No. 38), *Science and Education* (Science Masters' Association and Association of Women Science Teachers) and *Arts and Science Sides in the VIth Form* (Report to the Gulbenkian Foundation; Oxford University Press).

During the day various publications of interest, including a selection of those recently published by the Institute, were on view and for sale to members of the Association.

#### RECENT PUBLICATIONS

**British Chemicals and their Manufacturers.**—The Association of British Chemical Manufacturers has recently published a 1960 supplement to the 1959 edition of their directory, *British Chemicals and their Manufacturers*. The directory is published every two years, and the supplement provides full details of the many changes and additions in the list of products. The supplement is available *gratis* to all firms or persons genuinely interested in the purchase of chemicals and related materials. Inquiries should be addressed to the Association at Cecil Chambers, 86 Strand, W.C.2.

**Chemical Age Directory.**—The 332-page, 1961 edition of the *Chemical Age Directory and Who's Who* (one guinea to *Chemical Age* subscribers, two guineas to non-subscribers) contains a section on the structure of the British chemical industry, listing names of parent, subsidiary and affiliated companies. Other sections of the Directory have been revised and extended, and include details of more than 4,000 executives; lists of names and addresses of trade associations, learned societies, chemical sections of government departments and state undertakings, and U.K. research organizations; and chemistry teaching facilities at universities, colleges of technology and so on. There is also a comprehensive buyers' guide, containing more than 4,000 product headings in two sections, chemicals and plant and equipment. This is cross-referenced to a master index giving names and addresses of 1,700 companies.

**Organometallic Compounds.**—A new monthly periodical has recently been published by Translation and Technical Information Services, London (annual subscription £6). It is a compilation of abstracts on organometallic compounds, based on British and foreign scientific and patent literature. For the purposes of this abstract service, all the elements in the Periodic Table except H, B, C, O, Si, P, Te, the halogens and the inert gases are taken to be metals.

Current interest in the chemistry and applications of organometallic compounds is intense. Judging from the table of contents, the new journal is certainly ambitious in its scope, dealing, within the extremely arbitrary definition of a metal given above, with all aspects of the chemistry and production of organometallic compounds, the entire gamut of industrial applications and analytical uses. The extent of the coverage may be gauged from the number of entries in the pre-publication copy (December, 1960)—162—and, of these, a high proportion comes from the patent literature. Despite the tempo of Soviet research in this field no entry appears from the Russian literature.

An abstract service, to be of maximum usefulness, must be supplemented by a regular and comprehensive index service. It would seem that provision of indexes is not contemplated.

With these limitations the appeal of the new journal is bound to be very restricted.

J. IDRIS JONES

**Low Temperature Group.**—In consequence of the amalgamation of the Physical Society and the Institute of Physics in 1960, members of the Low Temperature Group of the Physical Society who paid a reduced annual subscription of 10s. 6d. by virtue of being members of the R.I.C. will now have to become Group Subscribers of the Institute of Physics and the

Physical Society, for which the annual fee is one guinea. The application form for Group Subscribership, which may be obtained from the offices of the Institute of Physics and the Physical Society at 47 Belgrave Square, London, S.W.1, should be completed and returned by 30 June.

**Industrial Finishes Exhibition.**—The First International Industrial Finishes Exhibition and Convention will be held at Earls Court, London, on 8–11 May. Further details may be obtained from the Exhibition Division, Scientific Surveys Ltd, 97 Old Brompton Road, London, S.W.7.

**Textile Dyestuffs and Finishes.**—The First International Textile Dyestuffs, Finishes and Auxiliaries Exhibition will be held at the Exhibition Hall, Harrogate, on 12–15 September. Admission is free, and tickets may be obtained from the organizers, Clarke & Rhodes Ltd, 274–278 The Corn Exchange, Manchester.

**Library of the Chemical Society.**—The Library will close at 1 p.m. on Thursday, 30 March, and will reopen at 9.30 a.m. on Wednesday, 5 April.

## CORRESPONDENCE

### ADVANTAGES OF A CHEMICAL APPROACH

SIR,—Mr Copley's somewhat carping criticism (*J.* 75) of Dr Day's recent paper (*J.*, 1960, 417) is regrettable, except in so far as it may have driven readers who previously missed the paper to read it. It is surely better that a teacher should have enthusiasm than otherwise, and his enthusiasm will almost inevitably lie in some particular direction, according to his training and experience. Individual leanings apart, the science of chemistry was the child of father Mineralogy and mother Pharmacy. There are two good reasons for our being patriarchal in Cumberland, firstly that our chemical industry is almost entirely of inorganic type, and secondly that the county is richer than any other, except perhaps Cornwall, in geological and mineralogical data. Accordingly, in this College our Grad.R.I.C. students take geology as their third ancillary subject without any other option—and like it.

I feel sure that Dr Day, as an organic chemist, would not mind in the least if chemistry teachers in other areas (Nottingham, for example) had a 'mother-fixation' and adopted a 'pharmaceutical approach.' The important thing is his plea that chemistry, while soundly based on the fundamental principles of thermodynamics and electricity, should be—and be clearly seen to be—related to real life, natural as well as industrial.

W. P. THISTLETHWAITE

Whitehaven College of Further Education,  
Flatt Walks, Whitehaven, Cumberland

### LABORATORY RISKS AND SAFEGUARDS

#### Opening of Sealed Ampoules

SIR,—Recent correspondence in your *Journal* (*J.*, 1960, 451; 1961, 37) would indicate the need for a few hints on handling sealed ampoules of low-boiling liquids.

These ampoules are normally made of soda-lime glass, and the manufacturer's advice is that they should be cooled down in ice-water before opening. If a lower temperature is thought necessary, they should be cooled in stages: ice-water, ice-salt freezing mixture, solid CO<sub>2</sub>-solvent—effecting a drop of some 20°C at each stage. This type of glass, of the thickness frequently encountered, will not stand much more without fracturing.

When opening the ampoules a scratch should be made with a sharp glass-knife or file partly round the neck about half an inch from the tip, and touched with the heated end of a glass rod. This rod may be about 2 mm in diameter, of soda glass, and the end face heated to softening in a bunsen or air-gas blowpipe flame. Normally this produces a crack travelling either way round the neck, and the tip of the ampoule is then picked off.

If it is required to re-seal the ampoule, it should first be cooled down in ice-salt freezing mixture, taking the above precautions and giving ample time, and should be well immersed. The tip of the neck is then rotated in a small blowpipe flame, and the glass pulled away using tweezers or a glass rod. Care should be taken to avoid suck-in or wrinkling at the seal, as this will lead to cracking.

So much for general precautions. The user, on his part, is entitled to expect to receive an ampoule which will stand up to average conditions; it should be well annealed, and the uneven thicknesses described in the *Journal*, and frequently encountered, seem excessive. A thermal shock test would reveal such faults, and a thermal shock of at least 40 or 50°C is suggested as a minimum requirement. Such a test would be carried out on an agreed sample number of empty ampoules, randomly selected from a consignment; these should be heated in a water-bath and plunged into cold water, giving the required temperature interval.

I. C. P. SMITH

Explosives Research and Development  
Establishment,  
Ministry of Aviation, Waltham Abbey

**Errata.** (1) The second sentence of the final paragraph on *J.*, 44 should read: 'Polythene production, which has grown so rapidly, is likely to continue its upward trend: capacity already exists among I.C.I., British Hydrocarbon Chemicals (jointly owned by the Distillers Co. and British Petroleum), Union Carbide/Bakelite and Monsanto for an increase of a third or more in output.' (2) The last sentence of the notice of the late James William George Brooker (*J.*, 76) should read 'He joined Price's Patent Candle Co. Ltd in 1906, and at the time of his retirement in 1947 was technical director of Price's Lubricants Ltd.' (3) In the list of deaths (*J.*, 77) for *Cranshaw* read *Cronshaw*.

## OBITUARY

**Theodore William Gull Acland.** *B.* 7.10.1890. *Ed.* Gresham's School, Holt; King's College, Cambridge, 1909-14; University of Berlin, April-August, 1914. M.A. (Cantab). After a short period in H.M. Forces, in 1915 he became one of several chemists responsible for starting up and running explosives factories at Langley Green and Chester. In 1920 he joined Brunner, Mond & Co. (now Imperial Chemical Industries Ltd) as a research chemist, and in 1922 became an assistant chemist in charge of the fuel department of Garton & Co., Battersea. He left the following year on his appointment as housemaster at Stowe School, Buckingham, where he remained until 1930, when he became headmaster of King Edward VI School, Norwich. He retired in 1943. (*A.* 1917). *D.* 13.10.60.

**Ernest George Beckett.** *B.* 12.5.1883. *Ed.* Bedford Modern School; Polytechnikum, Zürich, 1902-06. Dipl. Chem., Ph.D. He remained for a further two years at Zürich as assistant to Professor Treadwell, and in 1908 joined the British Aluminium Co. Ltd as a chemist. In 1911 he became a research and analytical chemist at Nobel's Explosives Co. Ltd (now Imperial Chemical Industries Ltd, Nobel Division). In 1919 he moved to Solway Dyes (later Scottish Dyes Ltd) and later that year went to Grangemouth as a research and superintendent chemist, becoming research manager in 1923 and works manager in 1929. He resigned his works manager's post to return to research work, and when he retired in 1945 he continued private investigations in the laboratory at his home, continuing to work until his death. He specialized in analytical methods as applied to anthraquinone products, and at Grangemouth his name will always be associated with the work he carried out on *p*-chlorophenol, phthalic anhydride and aluminium chloride. Chemistry played the most important part in his life, but he was well known in local musical circles and was a popular bridge player. (*F.* 1917). *D.* 27.11.60.

**Percy Ewart Bowles.** *B.* 6.12.1882. *Ed.* Finsbury Technical College; University of Heidelberg, 1904-09. Ph.D. He joined Derby Technical College as a lecturer in 1910, and remained until 1915, when he became a chemical works inspector under the Ministry of Munitions. The following year he took a post as works manager at Titamine Ltd. He left in 1919 on his appointment as chief chemist to the International Paint & Composition Co. Ltd, a position which he held until his retirement. (*F.* 1918; Council 1927-30). *D.* 13.10.60.

**Geoffrey Alfred Bracewell.** *B.* 1888. *Ed.* Bradford Grammar School; University of Leeds, 1904-05. For a few years he was assistant to F. W. Richardson before joining Cresswell's Asbestos Co. Ltd as an analytical chemist in 1910. Four years later he developed the brake and clutch bearings which were to make the firm's name. He remained with the firm for the rest of his life and at the time of his death was joint managing director. (*A.* 1915, *F.* 1918). *D.* 22.11.60.

**Ralph John Bressey.** *B.* 2.6.05. *Ed.* Hurstpierpoint College; Trinity College, Oxford, 1924-27. M.A., B.Sc. He joined Shell-Mex Ltd in 1928 as an assistant chemist in the central laboratories. A few months later he was appointed chemist and fuel technologist in the fuel oil department and later became head office supervisor, a position he also held in the black oils department of the war-time Petroleum Board. On the resumption of unit company trading in 1948 he became assistant fuel oil manager, and was appointed deputy manager of the department in 1950. Two years later he became fuel oil manager, a position which he held for the rest of his life. Early in his career he shared in the pioneering days of the high speed diesel engine for road vehicles, the development of diesel rail traction and diesel trawlers and the introduction of butane and propane for industrial purposes. He was erudite and keenly interested in the humanities. He also had an aptitude for commercial negotiations. No contract document was too abstruse and involved for his acute brain. He was a quiet and modest man, who nevertheless has left his indelible mark in solid achievement. (*A.* 1928). *D.* 27.10.60.

**Matthew Francis Stephen Choate.** *B.* 21.9.1884. *Ed.* Armstrong College, Newcastle upon Tyne, 1907-10. B.Sc.

(Durh.). After serving or a short time as an assistant to W. Ermen, consulting chemist, he took a post as a chemist to Jewsbury & Brown in 1911. He became a plant chemist at the Ministry of Munitions in 1915, where he remained for the duration of the war, and afterwards continued with Levinstein Ltd (now Imperial Chemical Industries Ltd) in a similar capacity. After his retirement in 1948, he became director of Dunn Bros, Manchester. His main interests were reading, gardening, walking and 'helping lame dogs over stiles'. (*A.* 1918). *D.* 7.8.60.

**Carl Coulson-Smith.** *B.* 30.9.1892. *Ed.* Armstrong College, Newcastle upon Tyne, 1912-16. M.Sc. (Durh.). He joined Dunstan Metal Works as a works chemist in 1916, and the following year became chief works chemist at Tyneside Alloys Co. Ltd. He was appointed analytical chemist to Michie and Davidson, consulting chemists, in 1919 and a year later became chief chemist to Allen-Liversidge Ltd. He left in 1930 on his appointment as chief of the chemical and metallurgical laboratories of the technical department, British Oxygen Co. Ltd, a post which he held until his retirement in 1956. (*A.* 1930, *F.* 1937). *D.* 23.7.60.

**Michael Grimwade.** *B.* 8.3.12. *Ed.* Gresham's School, Holt; Hertford College, Oxford. B.A., B.Sc. He became a works chemist at the British Oxygen Co. Ltd in 1936. He left in 1941 to take up a position as shift chemist at the Imperial Chemical Industries Ltd, Explosives Group, Ministry of Supply Factory at Powfoot, Dumfriesshire. At the time of his death he was a plant superintendent at Imperial Chemical Industries Ltd, Nobel Division, Ardeer. (*A.* 1934). *D.* 13.10.60.

**Frank William Helsby.** *B.* 25.9.1897. *Ed.* Brighton Technical College; King's College, London, 1919-21. B.Sc., Ph.D. He became an assistant to Professor J. F. Thorpe at the Chemical Defence Experimental Station, Porton, in 1922, shortly afterwards becoming a permanent member of that establishment. In 1940 he was seconded to the Ministry of Home Security. He joined the R.N.V.R. in 1943. At the end of the war, he was allowed to transfer to the Royal Naval Scientific Service at the Central Metallurgical Laboratory. He became deputy head of the chemical engineering division, Admiralty Materials Laboratory, in 1950, and at the time of his retirement he was head of the division. (*A.* 1922, *F.* 1951). *D.* 6.9.60.

**Bernard Farmborough Howard.** *B.* 30.4.1880. *Ed.* Marlborough College, 1894-98; Finsbury Technical College, 1899-1902. On completing his education he joined the family firm of Howards & Sons, Ilford, founded in 1797 by his great-grandfather, as a partner, and in 1903 became a director of Howards & Sons Ltd. He served for many years on the Pharmacopoeia Commission and was a member of the executive committee of the Drug and Fine Chemical Manufacturers' Association. In 1930 he gave the Streatfeild Memorial Lecture. He served with the Artists' Rifles during the First World War. When he retired from the Board of Howard & Sons Ltd in 1960, he was appointed President of the company. He rendered valuable service to the Institute in various capacities and was Hon. Treasurer, 1936-39. He was for many years a member of Chigwell Urban District Council and Epping Magistrates Bench, and a governor of Chigwell School, and on these and other bodies his sane and vigorous attitude to life continued to find expression until his death. He was a member of the Essex Hunt; perhaps the greatest interest of his last years, after his family, was Epping Forest, of which he was a verderer, and through which he had ridden regularly from childhood. He was the most modest and self-effacing of men, and will long be remembered in West Essex as a fine English gentleman. (*A.* 1904, *F.* 1907; Council 1927-30, 1936; Vice-President 1930-33; Hon. Treasurer, 1936-39). *D.* 19.11.60.

**Clifford Jones.** *B.* 30.7.05. *Ed.* Oulton Secondary School, Liverpool; University of Liverpool, 1924-27. B.Sc. He joined King's Lynn Beet Sugar Factory as a shift chemist in 1927 and thereafter became shift chemist, Oxford & Skipton Portland Cement Co. Ltd, 1928; assistant chemist, Carborundum Co. Ltd, 1929; and superintendent and chemist, Liptak Furnace Arches Ltd, 1941. Later in 1941 he was appointed research chemist at Pilkington Bros. Ltd, a position which he held for the remainder of his life. (*A.* 1945). *D.* 21.7.60.

**George Cecil Jones.** *B.* 10.1.1873. *Ed.* City and Guilds of London Central Institute, 1889-93. He became an assistant to Dr F. W. Passmore, consulting chemist, in 1893, and the following year joined the Dowson Gas Co. Ltd, Basingstoke, as a chemist. He left in 1902 on his appointment as managing chemist to Free, Rodwell & Co. Ltd. In 1907 he set up a consulting practice, which he maintained until his retirement in 1939. His main interest was gardening, but after a major operation in 1952 he was no longer able to pursue this actively. He educated himself in musical appreciation, making discerning use of the radio and the excellent concerts available in Hastings, where he spent many years of his retirement. He was re-learning Italian and French to the very last, and had absorbed all that was necessary for communication in Esperanto. He read widely and maintained a large correspondence. He could always be relied upon for sound judgment and good advice. Under a gentle, benign outward appearance he combined great physical caution with outstanding moral courage. He had a whimsical sense of humour, and was self-effacing, tolerant and always contented. (*F.* 1902). *D.* 30.10.60.

**Vallipuram Kulanayagam.** *B.* 1.6.08. *Ed.* Central College, Jaffna, Ceylon; University College, Colombo, Ceylon, 1926-28; Chelsea Polytechnic, London, 1938-39. He joined the Government Survey Department, Ceylon, in 1927, and the following year entered the Government Analyst's Department. He was appointed Assistant Government Analyst in 1940, Senior Assistant Analyst in 1943, and Deputy Government Analyst in 1955, a position which he held for the remainder of his life. He served on the Committee of the Ceylon Section of the Institute since its inception in 1953, and was Chairman in 1958. (*A.* 1939, *F.* 1948). *D.* 13.8.60.

**George Ashurst Liptrot.** *B.* 7.9.12. *Ed.* Ashton-in-Makerfield Grammar School; Wigan Mining and Technical College, 1928-36. He became a laboratory apprentice to the Pemberton Colliery and Dye Product Co. in 1927, and was appointed plant chemist to Thomas Witter & Co. in 1937. The following year he joined Imperial Chemical Industries (Explosives) Ltd as an assistant chemist, and remained there until 1949, when he became chemist to the Colliery Explosives Co. Ltd, Wigan. At the time of his death he was works manager with the same firm. (*A.* 1948). *D.* 12.6.60.

**George MacLennan.** *B.* 12.3.32. *Ed.* Dingwall Academy; University of Edinburgh, 1949-53. *B.Sc.*, *Ph.D.* He joined the U.K. Atomic Energy Authority, Windscale, as a scientific officer in 1955 and was transferred in 1957 to Dounreay, where he remained until his untimely death. He was promoted to senior scientific officer in 1958. His energy and enthusiasm for all he undertook set an example to all others. He was a gracious and charming friend, a man of the highest principles and steadfast in his faith. (*A.* 1956). *D.* 25.10.60.

**James McPherson Miller.** *B.* 14.9.1876. *Ed.* University of Manchester, 1894-97. *B.Sc.* He became a lecturer and demonstrator in chemistry at the Technical School, Birmingham, in 1899, and two years later joined Grant & Co. Ltd, Great Yarmouth, as a works chemist. *M.Sc.* He left in 1904 on his appointment as chemist to the Badische Anilin- u. Soda-Fabrik, Ludwigshafen, and was transferred to the Badische Co. Ltd, Manchester, in 1905, becoming joint manager of the Bradford branch two years later. When the firm closed down owing to the war, he joined British Dyes Ltd (now Imperial Chemical Industries Ltd) where he remained until his retirement in 1933. Thereafter he acted as consultant to the firm. He was greatly liked by those with whom he came into contact, kindly, and of a genial and generous disposition. (*F.* 1918). *D.* 21.11.60.

**Humphrey Desmond Murray.** *B.* 3.7.1899. *Ed.* Dover College; Christ Church, Oxford, 1913-23. *M.A.* He became an assistant lecturer at the Imperial College, London, in 1922 until 1929, when he set up the consulting practice of Murray, Bull & Spencer, of which he was managing director. The practice was later re-named Murray, Bull & Co. Ltd, and continued until 1953. Murray then joined the Ozalid Co. Ltd, and at the time of his death was technical director. He was the author of scientific papers and holder of patents. (*A.* 1925, *F.* 1933). *D.* 2.8.60.

**Marcus Norman Nicholson.** *B.* 17.9.1896. *Ed.* University of Glasgow, 1919-22. *B.Sc.* He became an assistant lecturer and analyst at the West of Scotland Agricultural College, Glasgow, in 1922. He left in 1926 on his appointment as head advisory chemist and analyst to the Agricultural Institute, Kirtom, Lincolnshire. In 1930 he joined the Ministry of Agriculture as a technical advisory officer, later becoming regional advisory soil chemist, South East Region, for the National Agricultural Advisory Service, Ministry of Agriculture, Fisheries and Food. (*A.* 1924). *D.* 6.10.60.

**David Luther Phillips.** *B.* 10.2.1891. *Ed.* Aberystwyth University College, 1908-12; Swansea Technical College, 1912-13. *B.Sc.* (Wales). He was appointed temporary lecturer at Swansea Technical College in 1915. He joined Baldwins Ltd as an assistant blast furnace manager in 1918, becoming sintering works manager in 1922, blast furnace manager in 1926 and works manager in 1928. He left in 1932 on his appointment as senior research officer to the South Wales Siemens Steel Association and the Welsh Plate and Sheet Manufacturers' Association at University College, Swansea. *M.Sc.* Later he became head of the laboratories of the British Iron and Steel Research Association. For a time he acted as external examiner in chemical engineering for the University of London. (*A.* 1918, *F.* 1943). *D.* 21.11.60.

**Alan Ashton Pollitt.** *B.* 10.1.1895. *Ed.* University of Manchester, 1912-15. *M.Sc.Tech.* He became a shift manager at the Ammonia Soda Co. Ltd in 1916, where he remained until 1918, when he joined the Royal Air Force as a technical officer in the photographic section. In 1919 he was appointed research chemist at the Metropolitan-Vickers Electrical Co. Ltd (now Associated Electrical Industries [Manchester] Ltd) and was promoted to chief chemist in 1924. He remained with the company for the rest of his life and was placed in charge of the chemistry laboratories. He was the author of papers in the scientific press and of *Causes and Prevention of Corrosion* (1923) and *The Technology of Water* (1924). (*F.* 1943). *D.* 23.10.60.

**William Redfern.** *B.* 18.8.04. *Ed.* Doncaster Grammar School; University of Sheffield, 1923-26. *B.Sc.* After a short period as a supply teacher at an elementary school, he joined the Billingham Division of Imperial Chemical Industries Ltd as an analytical assistant in 1928. He served as a shift analyst in a number of plants and remained with the company for the rest of his life. In 1945 he became a research assistant and was later appointed technical officer (chemical) in the Heavy Organic Chemicals Division. (*A.* 1947). *D.* 8.10.60.

**Ernest Woodhouse Smith.** *B.* 13.2.1884. *Ed.* Arnold House School, Blackpool; University of Manchester. *D.Sc.* After leaving the University, he spent a year in the North-West Territories of Canada to report on the working of the South Saskatchewan Gold & Platinum Extraction Co. On his return he was appointed research chemist to the Gas Heating Research Committee of the Institution of Gas Engineers at the University of Leeds. In 1910 he joined the Birmingham Gas Department to organize the new industrial heating research laboratories, and in 1912 became chief chemist. During the First World War he carried out much research work for the Ministry of Munitions. In 1920 he became technical director to the Woodall Duckham companies, and during the Second World War he was for a period controller of gas supplies. He later became the first chairman of the Industrial Coal Consumers' Council, a position which he held until his final retirement. In 1943 he received the Birmingham Medal, the highest award of the Institution of Gas Engineers, and in 1947 the honour of knighthood was conferred upon him; he had earlier been appointed C.B.E. 'He appreciated frankness, could himself be outspoken, be both good humouredly persuasive and firmly determined; and above all was a man whose wisdom and experience helped the many who sought his counsel.' (*F.* 1917; Council 1919-22). *D.* 7.11.60.

**Ralph Hayden Spettigue.** *B.* 18.6.1900. *Ed.* Royal College of Science, London, 1919-22. *B.Sc.* He joined the Ever Ready Co. (Great Britain) Ltd in 1922 as a works chemist, and was promoted to manager in 1925. He remained with the company for the rest of his life, and at the time of his death he was a director, a position which he had held since 1943. 'He was very modest, exceedingly humane with a keen sense of duty. His foresight

and administrative gifts contributed largely to the success of the Company, of which he was technical director. It was most unfortunate that he did not live to see the establishment of the Company's new research laboratories.' (A. 1922, F. 1957). D. 15.11.60.

**Alec Bowring Steven.** B. 16.8.1877. Ed. New College, Eastbourne; University College, London, 1895-1900. B.Sc. He proceeded to the Yorkshire College (now the University of Leeds) in 1901 to study dyeing for a year, and in 1902 became assistant lecturer in dyeing at the College. In 1908 he was appointed to the newly instituted lectureship in dyeing, calico printing and bleaching at the Royal Technical College (now the Royal College of Science and Technology), Glasgow. His title was later changed to lecturer in colour chemistry and dyeing, and he retained this position until his retirement. He was the author of scientific papers. (F. 1918). D. 11.10.60.

**Richard Thomas.** B. 6.2.1889. Ed. Caernarvon County School; University of Wales (Bangor), 1906-09. B.Sc., 1909. He carried out research under Professor K. J. P. Orton at Bangor, 1909-10. M.Sc. He proceeded to Leipzig University, where he worked under Professor Hantzsch for two years, then returned to work for one year under Professor H. B. Baker at the Royal College of Science. In 1913 he was appointed research chemist to Lever Bros Ltd, at Port Sunlight, and in 1946 head of the research laboratories there, a position he held until his retirement in 1954. In 1924 he received the D.Sc. degree of the University of Wales; he was also a Fellow of his University. His research and publications until he entered industry were in the physico-chemical field, and his marked ability as a physical chemist and mathematician continued to be evident throughout his industrial research. Initially, this was mainly concerned with the hydrogenation of oils and fats, a subject then in its infancy. As a result of his efforts, considerable progress was made in technical hydrogenation, both in respect of catalyst preparation and improvement in efficiency from knowledge of the importance of catalyst poisons.

His later career was mainly concerned with the development of new detergents, both saponaceous and synthetic. In the latter field he was one of the pioneers, and to him probably more than any other individual is due the first use of fluorescent whitening agents. His duties involved journeys to the U.S.A., South Africa and many Continental countries. Throughout the Unilever organization he was recognized as an expert in his field, and was well regarded as a colleague and a man. He held a number of patents. He was a founder member of the Liverpool and North-Western Section of the Institute, and served as its Chairman. He was renowned for his brilliant after-dinner speeches, which were penetrating, witty, and entertainingly delivered. (A. 1918, F. 1924; Council 1927-28). D. 25.11.60.

**Thomas Tickle.** B. 11.6.1871. Ed. Shebbear College; School of the Pharmaceutical Society, London, 1892-94. B.Sc. He spent some time in research under the direction of Dr Norman Collie, and after a short period in industry, returned to Devon, his native county, on his appointment as Public Analyst to the City of Exeter in 1901. Shortly afterwards he was appointed Public Analyst for the County of Devon, and later for Plymouth and Torquay. For many years he was an examiner for the Universities of London and Wales, and was a member of the British Pharmacopoeia Commission, 1932-48. By upbringing a countryman, he had a great love of the sea; his main recreation for many years was sailing, which he continued until 1939. He did not, however, desert the countryside, where he spent many hours bird watching. Those who had the good fortune to work under his guidance will remember him not only with affection but also with a feeling of gratitude for the benefits of the very sound training that they received at his hands. (A. 1900, F. 1903; Council 1916-19). D. 29.10.60.

**Frank Wade.** B. 19.4.1878. B.Sc. (Lond.). He joined the War Department as a chemist in 1900 and the following year transferred to the Admiralty. He served in H.M. Forces during the First World War, attained the rank of captain and received the T.D. He returned to the Admiralty in 1919 and remained there until 1927, when he retired owing to ill-health. (A. 1901, F. 1904). D. 18.10.60.

## THE REGISTER

### NEW FELLOWS

- (FF) DALDY, Francis George, B.Sc.(OXON.)
- EDWARDS, William George Henry, B.Sc., PH.D.(LOND.)
- (U) JORDAN, Arthur, D.D.E L'U.(STRAS.), M.B., B.S.(LOND.), M.R.C.S., F.R.C.P.
- (Y) VENANZI, Luigi Mario, M.A., PH.D.(OXON.), D.SC.NAT. (TRIESTE), DIPL.CHEM.(KIEL)
- (C) WILSON, Barbara Mary, B.Sc., PH.D.(LOND.)

### ASSOCIATES ELECTED TO THE FELLOWSHIP

- (S) BRAGG, Dorrell Raymond, B.Sc., B.PHARM.(LOND.), F.P.S.
- (P) CHAMBERLAIN, Norman, B.Sc., PH.D.(BIRM.), M.I.BIOL.
- (E) COOPER, William, B.Sc.(LOND.), A.M.I.CHEM.E.
- (Q) CULLUM, Douglas Charles, B.Sc.(LOND.)
- (N) DUNBAR, James
- (P) EXCELL, Harold Cyril, M.Sc.(LOND.), M.INST.GAS E.
- (E) GRIFFITHS, Peter John Felix, M.Sc.(WALES)
- (Y) GRIFFITHS, Thomas William, B.Sc.(WALES)
- (P) HERNIMAN, Peter Douglas
- (P) HILLS, Graham John, B.Sc., PH.D.(LOND.)
- (OC) HUNT, Ian Sinclair, M.Sc.(N.Z.), A.I.M.
- (T) JENKINS, Charles Delme, Ph.C., F.P.S.
- (N) JONES, Deity Wynn, B.Sc.(MANC.), PH.D.(LEEDS), A.INST.P.
- (P) LARGE, Ernest Charles, B.Sc.(LOND.)
- (P) LOEWENSTEIN, Klaus Leopold, B.Sc.(LOND.)
- (P) MURFITT, Kenneth Cecil, M.Sc.(LOND.)
- (P) SHER, Harry Nathan, B.Sc.(LOND.), A.R.C.S.
- (P) SIMMONS, John Ralph
- (H) SNOWDEN, Arthur Henry, Ph.C., F.P.S.
- (P) SPICKETT, Robert Geoffrey William, B.Sc., PH.D.(LOND.)
- (Q) VEITCH, David Pentland, B.Sc.(LOND.)
- (X) WAY, William John Raymond, M.Sc.(BIRM.)
- (P) WHITNEY, John Edward Seager, B.Sc.(LOND.)
- (P) WILLIAMS, Frederick Ronald, B.Sc.(WALES)

### NEW ASSOCIATES

- (EE) ANDREWS, John James, B.Sc.(LIV.)
- (P) BARKLEY, Harty, B.Sc.(LIV.), M.B., B.S.(LOND.), M.R.C.S., M.R.C.P.
- (J) BROCKLEBANK, William, B.Sc.(EDIN.)
- (Y) BROD, Manfred, B.A.(OXON.)
- (D) CLAMP, John Richard, B.Sc.(BRIST.)
- (D) COLEHAN, Joseph Edward, B.Sc.(LOND.), A.M.I.CHEM.E.
- (E) GEORGE, David Valentine Edgar, B.Sc.(WALES)
- (R) HOWELL, Gareth, B.Sc.(LOND.)
- (FF) KIRBY, Edward Cameron, B.Sc.(ST AND.)
- (H) LECKEY, Robert Graham, M.Sc.(BELF.)
- (R) MACFARLANE, Alan James, B.Sc.(WALES)
- (Y) NASH, James Reuben
- (E) OWEN, Eryl Davies, B.Sc., PH.D.(WALES)
- (P) PEARCE, Alan Sidney, M.Sc.(DURH.)
- (P) PEARSON, Ronald George, B.Sc., PH.D.(LOND.)
- (Q) PROCTOR, Michael Hugo, B.A.(DUBL.), M.S.(WIS.)
- (Y) SHONE, Geoffrey Graham, B.Sc.(DURH.)
- (N) WAINWRIGHT, Paul, B.Sc.(LEEDS)
- (P) WARREN, Roy Kenneth, B.Sc.(LOND.)
- (G) WILSON, Roy Geoffrey, B.Sc.(LOND.)

### GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

- (B) BADMAN, Hugh Godfrey, B.Sc.(BRIST.)
- (N) BALDWIN, George Peter, DIP.CHEM.
- (P) BIERNACKA, Anna Cornelia, B.Sc.(LOND.)
- (P) BIRD, Albert Eric, B.Sc.(LOND.)
- (N) BRADBURY, Donald
- (SS) BULLOUGH, Kenneth Richard
- (K) CAMERON, George Gordon, B.Sc.(GLAS.)
- (P) CATTERALL, Arthur John, M.A.(CANTAB.)
- (P) CHESHIRE, John David, B.Sc.(LOND.)
- (P) CHONG, Vee Yong, B.Sc.(LOND.)

## LOCAL SECTIONS DIARY

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated. For key to Local Sections see J., 78.

- (O) COLLINS, Anne Elizabeth, M.Sc.(LIV.)  
 (WW) DE BANZIE, Ian Foster  
 (C) EATON, Eric Charles, DIP.TECH.(BIRM.)  
 (R) ELLIOTT, George Edward Peter  
 (P) GILDERSON, David John  
 (J) GILL, John Bernard, B.A., B.Sc.(OXON.)  
 (P) HILL, Robert Deryck, B.Sc., PH.D.(MANG.)  
 (O) JOHNSON, Eric George  
 (P) JOHNSTON, Eric, M.A.(OXON.)  
 (Y) KAY, Ralph, B.Sc.(STON)  
 (D) KINGSTON, Alfred George  
 (Y) LODGE, John Ewart  
 (H) MARRIOTT, John Ernest, B.Sc.(R'DG)  
 (O) MATTHEWS, David Ian  
 (Y) PARKER, Raymond John Louis, B.Sc.(LOND.)  
 (C) PUTNAM, Andrew Kenneth, B.Sc.(BIRM.)  
 (Y) REDMAN, Michael John  
 (WW) RENWICK, Gordon McArthur, B.Sc.(ST AND.)  
 (J) ROSS, Kenneth McDonald, A.H.-W.C.  
 (P) SAUNDERS, Harry Frederick William, B.Sc.(LOND.)  
 (O) SCOTT, Richard  
 (Q) SHACKLETON, Frank, B.Sc.(MANG.)  
 (P) SHENTON, Agnes Jean, B.Sc.(LOND.)  
 (P) STOKES, John Leslie, B.Sc.(LOND.)  
 (N) SUNDERLAND, Jean Margaret  
 (M) TAYLOR, David Frederick, B.Sc.(LOND.)  
 (H) TEBBY, John Caesar  
 (N) THORNE, Derek Henry  
 (O) TREVALION, Peter Asquith  
 WALKER, Brian Lawrence Hammond, A.C.T.(LIV.)  
 (Q) WESTWELL, Alan, B.Sc.(LOND.), A.R.T.C.S.

## NEW GRADUATE MEMBERS

- (C) BARNETT, David Michael, B.Sc.(MANG.)  
 (P) BRADDOCK, John Michael Fulks, M.Sc.(DURH.)  
 (P) CHURCHYARD, John Gordon, B.Sc.(LOND.)  
 (Y) HILL, Russell John, B.Sc.(WALES), PH.D.(LOND.), D.I.C.  
 (P) HOWELLS, Vincent William, B.Sc.(WALES)  
 (R) LAIRD, Robert McCrone, B.Sc.(GLAS.)  
 (P) LAYE, Peter George, B.Sc.(LOND.)  
 (K) PARKER, James Brown, A.R.C.G.S.T.  
 (K) STIRLING, David George Neilson, B.A.(CANTAB.)  
 (X) WALTERS, Raymond, B.Sc.(DURH.)

## STUDENT ELECTED TO THE ASSOCIATESHIP

- (P) WILSON, Keith, B.Sc.(HULL)

## DEATHS

## Fellows

- (P) ALLEN, David George, B.Sc.(LOND.). Died 17 January, 1961, aged 38. A. 1945, F. 1949.  
 (C) COWAN, John Galloway, B.Sc.(LOND.). Died December, 1960, aged 58. A. 1924, F. 1930.  
 (Q) GAUNT, Rufus, M.Sc.(LEEDS), PH.D.(BERL.). Died 19 January, 1961, aged 79. A. 1922, F. 1926.  
 (H) KEYS, William Harold. Died 7 January, 1961, aged 75. A. 1903, F. 1920.  
 (U) LYNAM, Thomas Rickman. Died 4 February, 1961, aged 53. F. 1944.  
 (SS) PHILLIPS, Donald Ford. Died 2 February, 1961, aged 53. A. 1948, F. 1956.  
 (SS) WILDE, William. Died 30 November, 1960, aged 79. A. 1918, F. 1924.

## Associates

- (P) BALLS, Ernest George, M.C., B.Sc., PH.D.(LOND.). Died 4 February, 1961, aged 73. A. 1919.  
 (P) CRACKNELL, John Richard, M.A.(OXON.). Died 30 January, aged 33. A. 1952.  
 (N) McDONALD, Alexander, B.Sc.(GLAS.). Died 23 January, 1961, aged 60. A. 1924.  
 (L) MELLOR, Joseph Crossland, B.Sc.(EDIN.). Died 27 January, 1961, aged 67. A. 1920.

- (B) Belfast. 27 Mar. 7.45. Annual General Meeting. Chemistry Lecture Theatre, Queen's University, Stranmillis Road  
 (O) Birkenhead. 27 April. 7.30. Some Aspects of Biosynthesis. Prof. A. J. Birch. Technical College  
 (C) Birmingham. 22 Mar. 6.30. Annual General Meeting  
 (D) Bristol. 23 Mar. Ladies' Night. Frozen Foods. Birds Eye Foods Ltd. College of Science and Technology, Ashley Down  
 (E) Cardiff. 19 April. 7. Infra-red Spectroscopy. Dr L. J. Bellamy. University College. Joint, S.C.I.  
 — 28 April. 7. Modern Legislation in Relation to Food Additives. C. A. Adams. University College. Joint, S.A.C., S.C.I. (S. Wales) and S.C.I. (Food Group)  
 — 26 May. Annual General Meeting. Royal Hotel  
 (P) Chatham. 6 April. 7.30. Isotopes in Industry. W. G. Busbridge. Medway College of Technology, Maidstone Road. Joint, Institute of Petroleum  
 (F) Cork. 21 April. The Chemist and the Internal Combustion Engine. W. S. Sellers. University College. Joint, C.S., S.C.I. and Institiuid Ceimice na h-Eireann  
 (R) Cowes. 27 May. Annual General Meeting, followed by annual outing  
 (H) Derby. 23 Mar. 7.30. Annual General Meeting, followed by Film Evening. Lecture Theatre, College of Art  
 (F) Dublin. 19 April. The Chemist and the Internal Combustion Engine. W. S. Sellers. Trinity College. Joint, C.S., S.C.I. and Institiuid Ceimice na h-Eireann  
 (FF) Dundee. 21 April. 7.15. Modern Aspects of Inorganic Chemistry. Prof. R. S. Nyholm. Queen's College  
 — 5 May. 7.15. Annual General Meeting. Queen's College  
 (F) Galway. 24 April. The Chemist and the Internal Combustion Engine. W. S. Sellers. University College. Joint, C.S., S.C.I. and Institiuid Ceimice na h-Eireann  
 (K) Glasgow. 12 May. Fourth Henderson Memorial Lecture: Tobacco Smoke and Lung Cancer. Dr J. W. Cook  
 (P) Hendon. 29 Mar. 7.30. Public Lecture: The Story of Soap and the Growth of Modern Synthetic Detergents. Dr K. G. A. Pankhurst. Technical College  
 (L) Huddersfield. 23 Mar. 7. Annual General Meeting, followed by Scientific Film Evening. Alexandra Chambers, 32 John William Street  
 — 18 April. 7.30. The Identification of Dyes in Substance and on Fibre. G. W. Midgell, Silvio's Restaurant, Westgate. Joint, Society of Dyers and Colourists  
 (M) Hull. 13 April. 6.45. Annual General Meeting, followed (7.30) by Insect Biochemistry in Relation to Selective Toxicity. F. P. W. Winteringham. Organic Lecture Theatre, The University  
 (SS) Lancaster. 6 April. 7.30. Annual General Meeting, followed by 'Colour'. L. V. Jones  
 (O) Liverpool. 6 April. 6.15. Annual General Meeting, followed (7) by Principles and Chemistry of Colour Photography. Dr E. B. Knott. Donnan Laboratories, The University, Vine Street  
 — 15 April. Symposium on Teaching of Inorganic Chemistry at Pre-University Levels. Donnan Laboratories, The University, Vine Street  
 (P) London. 24 April. 7. Fifth Ladies' Evening: Gem Stones. R. C. Chirnside. The Royal Institution, 21 Albemarle Street, W.1.  
 (P) Linton. 19 April. 8.30. Chemotherapeutic Research. Dr F. L. Rose. College of Technology. Joint, Luton Sci. Assoc.  
 (Q) Manchester. 6 April, 2-8; 7 and 10 April, 10 a.m.-8 p.m. 1961 Annual Exhibition of Scientific Apparatus. Manchester College of Science and Technology  
 (S) Newcastle. 5 May. 6.30. Annual General Meeting, followed by lecture on Sherry. D. M. G. Lloyd. Chem. Dept., King's College  
 (E) Newport. 24 Mar. 7. Lecture by Dr E. M. Evans. College of Technology, Allt-y-rn. Joint, S.C.I.  
 (W) Plymouth. 24 Mar. 4.30. Annual General Meeting. Followed by: Priestley's Airs and Waters. Dr F. W. Gibbs. Technical College  
 (O) St Helens. 23 Mar. 7.30. The Structure and Stability of Atomic Nuclei. Dr A. A. Jaffe. Technical College  
 (EE) Seascale. 14 April. 8. Scientific Films. Windscale Club  
 (U) Sheffield. 27 Mar. 7. Public Lecture: Plastics and Fibres. Prof. C. E. H. Bawn. Chemistry Lecture Theatre, The University, Brookhill  
 — 4 May. 7.30. Annual General Meeting. Chemistry Lecture Theatre, The University, Brookhill  
 (R) Southampton. 6 April. 7.30. Recent Developments in Dekin. Dr G. F. C. Barrett. The University. Joint, Plastics Institute and S.C.I.  
 — 20-22 April. Institute Annual Conference  
 (G) Stowmarket. 28 Mar. 7.30. New Organic Surface Coatings. M. W. Thompson  
 (V) Swansea. 5 May. 3. Visit to new University Chemistry Laboratories. 6.15. Annual General Meeting, Department of Chemistry, The University College  
 (T) Wrexham. 26 April. 7. Some Aspects of Colour Reproduction. Dr H. Baines